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Welfare Sheet: *Broiler chickens*

Chickens specially bred for **meat production** are called '**broiler chickens**' or '**broilers'**. Typically, broilers are young chickens which have white feathers and yellowish skin. Since the 1940s, strong consumer demand for affordable, safe and healthy poultry meat has stimulated the growth of the broiler industry. Genetic selection and improved nutrition have been used to increase the weight of breast-muscle (leading to broader breasts) and faster growth rates. However this has had implications for the quality of life, health and walking ability of broiler chickens[1]. Globally, over **70% of broilers are raised in industrial farming systems**[2] and **slaughtered at an age of around 5 – 7 weeks depending on the country they are reared in.** In the UK, the rest of the EU, USA, Brazil and China the majority of chicken meat originates from intensive systems. This type of production is rapidly being replicated in developing countries[3].

This document gives an overview of the **different welfare problems** that are associated with intensive meat chicken production. It will also outline how these welfare problems may be overcome in housing systems that offer an alternative to intensive production. There are serious welfare issues associated with the breeding and intensive rearing of broilers and it is generally accepted that **most of the welfare problems are caused by genetic factors, environmental factors** and the interactions between them[4].

A typical broiler chicken is a young bird (with a less developed comb and wattles) that only lives for about 5 – 7 weeks before slaughter depending on the country it is reared in.

Welfare issues associated with intensive rearing systems

Genetic selection for fast growth

Broiler chickens are among the fastest growing farmed species. **Intensive genetic selection** has led to birds that have a **typical average daily weight gain of about 50 g.** However, some breeds grow as much as 90g/day[5] and at over 35 days more than 100g/day. The intensity of genetic selection over the last 80 years or so, the age of slaughter has been decreasing 1 day a year, and market weight increasing.

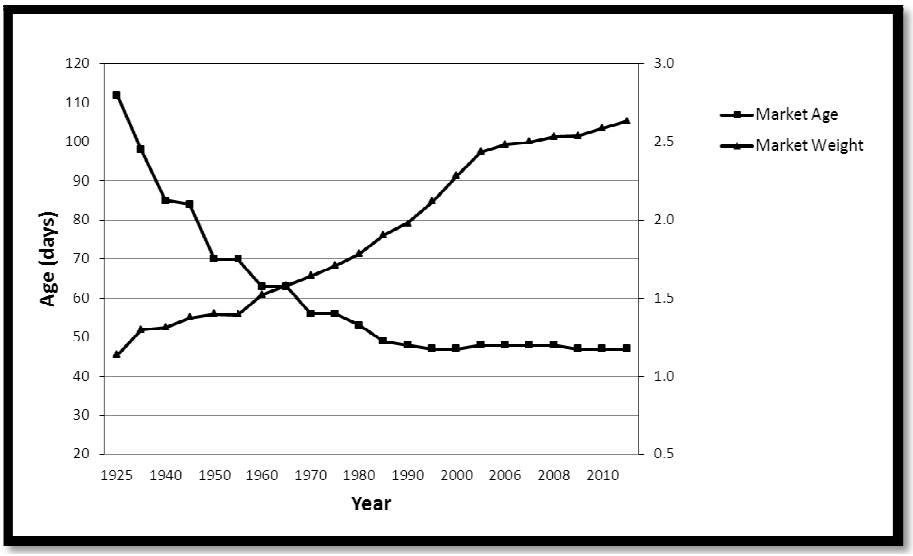

Figure 1. Market age and weight changes since 1925 of commercial broiler chicken production in the US (slaughter birds at around 7 weeks)[6].

Welfare issues specific to fast growth rates:

- **Higher Mortality:** The average mortality (including spontaneous deaths and the culling of diseased birds by stock people) was **2.9%** in one large study[7] (18% was not unusual in the 1920s[8]). Changes in breeds, growing period, management and disease control have improved levels but rapid growth rates still result in many mortalities. The larger EU broiler companies (that slaughter at an age of 32 to 40 days), work to reduce overall mortality to less than 5% in the production period[9].

- **Increased risk of lameness:** Skeletal disorders such as bone deformity and other leg disorders can lead to impaired walking abilities and lameness. Lameness problems are multi-factoral but studies have shown that fast-growing chickens have higher rates of lameness compared to slower-growing breeds. Birds with severe walking problems are experiencing **pain**[10]. Rapid growth of broilers results in a **quick increase in body weight**, which puts their skeletal system under stress. When this happens, fast growing chickens become less active and have more **leg disorders**. However, the legs of slower growing broilers are better able to carry their body weight, and this does not lead to bone and joint problems[11].

  A large study found that on average **57% of the fast growing birds had severe walking problems,** whereas flocks with alternative, slower growing strains only about 17% had severe walking problems[12]. In 2008, a survey of 176 UK broiler flocks (representing 4.8 million broilers) found that 27.6% had severe walking problems and 3.3% were almost unable to walk; overall 97.5% of the birds had some degree of gait abnormality[13]. Breeding programs have helped improve overall bone quality and leg health but some advantageous genetic changes are leading to new bone problems, such as black bone syndrome, make bones more porous, so more likely to break[14].

Broilers with leg problems are common in intensive systems. Leg weakness leads to lame and lethargic birds that are not able to move.

- **Contact dermatitis:** Inflammation of the skin on the breast, hocks and feet (also called **footpad dermatitis or FPD**) is a widespread problem in broiler production and is often more severe in fast growing birds. Its caused by prolonged contact between the bird's skin and wet and dirty litter, but several other factors such as health, diet, and (indoor) climate also play a role (see below)[15]. In severe cases the lesions can develop into inflamed ulcers which cause pain.

Overtime the birds' droppings mix with the litter on the floor. Wet litter can lead to soiled birds which can develop into FPD.

A study in EU slaughter houses found that:

- Prevalence of **hock burns** was about **20% in standard, fast growing** broilers and less than 1% in slower growing broilers from alternative housing systems.
- Prevalence of **foot pad dermatitis (FDP)** in these flocks was about **22% in standard fast growing** broilers and around 7% in slower growing broilers[16].

Following the introduction of the EU Broiler Directive, the welfare condition of broilers must be assessed and used as an indicator for the welfare level on the farms from which the broiler flocks come. Several Member States (UK, The Netherlands, Denmark and Sweden) include footpad dermatitis as a welfare indicator at slaughter in this assessment.

- **Heart disease:** Fast growing birds (and more males than females) can develop deadly heart conditions such as **'ascites'** (fluid in the gut which can lead to cardiac failure) and **'sudden death syndrome'. Fast growth rates increase the risk of these two conditions** through an increased demand for oxygen putting pressure on the heart and lungs. In healthy flocks of broilers, sudden death syndrome is the most frequent cause of death. This disease is also called flip-over-syndrome, as the animals are often found lying on their backs. It poses serious welfare concerns, because of the quick onset of the disease in animals that appear to be in good condition and its symptoms (wing flapping, muscle contractions and loss of balance), is rapidly followed by death[17].

- **Lethargy:** Broilers have to adapt their physiology and behaviour to maintain their fast growth rate (e.g. they need to conserve energy). When compared with other poultry, they are less active. Fast growing broilers spend less time in walking/running, scratching/pecking litter and perching, and more time in sitting and eating/drinking than slow growing birds[18]. This does not mean that the fast growing birds do not want to be active (they are still motivated to perform important behaviours such as foraging), however, they are physically unable to do so, as their legs aren't strong enough to support the weight of their body[19].

Welfare issues specific to high stocking densities:

As broilers grow older they get bigger taking up more space, causing less space per bird. Published research has consistently indicated that **the health and welfare of broilers is compromised at stocking densities above the range 34 - 38 kg per square metre**[20]. Stocking density in commercial systems has increased over time, often 39kg/m^2 or higher, primarily driven by economics, but the profits per unit of space tends to plateau with excessive stocking densities, due to reduced bird performance[21] (e.g. reduced growth rate[22]).

Young broiler chicks, a few days old after placement into a broiler shed.

- **Reduced ability to exhibit natural behaviours:** When stocking densities increase, it becomes increasingly harder to move around. This leads to less time spent walking and shorter distances covered, and also to a lot of jostling amongst the birds. It becomes harder for animals to reach their target (such as food and water), because they have to avoid other birds or walk over them. It has also been shown that with increasing densities, broilers have shorter preening sessions due to disturbances[23]**.** Broilers are young animals and they

will rest a lot during the day. These day-time rest periods may get disturbed due to high stocking densities; this can have implications for welfare[24].

- **Restricted movement:** Both restricted movement and disturbed rest will impact on the birds' physical development, with possible welfare consequences for poor bone development, leg abnormalities and contact dermatitis (see above)**.**

- **Poor environment:** Pollution (e.g. ammonia from droppings), wet litter and higher temperatures are all a problem due to the increased biomass (the number of the chickens in one space). Limiting stocking densities without adequate control over the environment will therefore not automatically lead to the expected improvements in welfare[25].

- **Poor welfare management practices:** The practice of '**thinning**' a flock is commonly used in the broiler industry (in the EU but not US) and involves the catching and removal of a portion of the flock (usually the female birds that are lighter) for slaughter, to allow the remaining birds more room to grow on to a greater weight[26]. This process causes multiple episodes of stress and potential injury to the animals during catching (see section on catching below) as well as an increased risk of *Campylobacter* in the remaining flock which causes food poisoning in people[27]***.***

Welfare issues specific to environmental conditions (e.g. air quality, ventilation, temperature, litter quality):

Tightly packed broilers with fan ventilation for temperature and humidity control.

The environment of intensively kept broilers will affect their health and welfare as they can't move away if conditions become aversive. Especially indoors, the environment is a combination of physical, chemical and biological factors between birds, husbandry system, light, temperature and the aerial environment[28].

- **Poor air quality:** The aerial environment includes temperature, humidity, dust levels and concentrations of gasses such as carbon dioxide, carbon monoxide and ammonia (from the bird's waste). The welfare of birds may be compromised by chronic exposure to aerial pollutants such as ammonia, dust and pathogens, as these can be damaging to the eyes and respiratory system[29]. These pollutants originate from the feed, the litter and the chickens themselves. High levels of humidity can lead to more birds dying over the growth period[30]. Adequate ventilation provides the most effective method of controlling humidity within the house[31]. Ammonia can irritate eyes, throat and mucous membranes (e.g. present in the lungs). When broiler chickens are given a choice they will actively avoid areas where ammonia is present[32].

Fast growing birds find it harder to dissipate heat and can become heat-stressed.

- **Temperature and heat stress:** Fast growing broilers may have problems in dissipating heat and can easily become heat-stressed. Their first response to a heat challenge is to reduce walking, standing and preening. Panting is also common and indicates that thermal discomfort becomes a problem at higher stocking densities[33]. If ventilation is not managed properly, birds may die as a consequence of elevated temperatures[34].

- **Reduced litter quality:** The litter in a broiler shed is not usually cleaned out during the birds' lifetime for biosecurity reasons. The litter quality will influence environmental dust levels, air humidity and ammonia levels, these factors are associated with the risk of developing respiratory problems (see above). Litter quality also has a direct influence on the skin condition of the birds, as wet litter is a major risk factor for contact dermatitis (see section on contact dermatitis above)[35]. Litter can become wet due to factors such as the type of litter material, the type of drinkers and water spillage and diet composition, as this affects the composition of the bird's faeces (e.g. diarrhoea)[36]. The moisture and ammonium content of litter increases rapidly with increasing age[37]. Wet litter is a common problem, for example, in a 2001 UK survey, 75% of farmers reported wet litter[38]. Litter of good quality enables the birds to perform litter-directed behaviour such as dustbathing and scratching (a foraging behaviour), however when the litter is wet and dirty it becomes harder to perform these behaviours. Dustbathing is an important maintenance or comfort

behaviour (or behavioural need) that is displayed by virtually all birds. The principal functions of dustbathing are the removal of surplus lipids from the feathers, improvement of feather structure and the removal of ectoparasites[39].

- **Lighting:** In countries without legislation on lighting schedules broilers can be kept in artificial light for long periods of time, done to stimulate growth, as the birds only eat in the light. This causes the birds to become exhausted. The EU legislation requires periods of darkness lasting at least six hours, with at least one uninterrupted period of darkness of at least four hours, to be provided daily and during most of the chicken's life[40]. In comparison the US voluntary guidelines, recommend a minimum of 4 hours of darkness in a 24-hour period (excluding the first and last week of life). However, during this so-called 'darkness' the guidelines permit birds to be housed with dimmed lights, rather than in total darkness. Furthermore, the darkness does not have to be continuous and can be given in 1, 2 or 4-hour periods[41]. Longer periods of darkness are known to be beneficial as they reduce leg problems which is the main cause of reduced welfare in broiler production systems (see below)[42].

Higher welfare systems for broiler chickens

Alternative broiler farming systems address the two main issues that impact on broiler welfare: the genetic selection for fast growth and stocking densities (as discussed above). Alternative systems offer the **potential for higher welfare** compared to intensive systems[43].

Free range housing allows birds to range outside during the day.

Chickens in alternative systems have improved welfare due to:

- **More space**: Broilers in (well managed) free range systems are active outdoors, range extensively and can exhibit natural behaviours such as ground pecking, scratching, dust-bathing and foraging[44] [45]. Indoor housing should also have lower stocking densities than standard intensive sheds.
- **Slower growth rates**: Slower growth allows the animals developing physiology, to support the increase in body weight and develop greater leg strength. When housed in systems with lower stocking densities, greater leg strength enables the birds to be more active[46]. Slower growing birds stocked at lower densities had better walking ability, fewer hock and footpad burns, fewer DOA's and lower mortality[47] [48].
- **Enriched environment**: Indoor enrichment and/or with an outdoor area is provided for birds allowing them to express more natural behaviours such as scratching, perching and outside dust-bathing and foraging. There is also the provision of natural light.

Welfare is not guaranteed, as this also largely depends on good management. However, alternative systems should achieve higher standards of health and welfare and offer an optimum quality of life for broilers from day-old to the point of slaughter. Studies have shown that welfare outcomes can be good in alternative systems.

Alternative systems

Higher welfare indoors
Chickens are kept indoors but they have more space and are of breeds of intermediate or slower growth rates as compared to intensive breed. The indoor environment has natural daylight (windows) and is enriched to provide a diverse environment, allowing perching and foraging behaviours.

Example of farm assurance schemes: *Freedom Food* (set up by the RSPCA in the UK)[49]. *Beter Leven, 1 star* (set up by the Dutch animal protection society, de Dierenbescherming, in The Netherlands)[50].

Higher welfare indoor sheds give natural light to birds, along with enrichment like bales of straw and perches.

Free range
Chickens are given access to an outdoor range during the daytime for at least half of their lifetime and the birds used are often slower growing breeds. According to EU marketing standards for poultry meat[51], the birds must be at least 56 days old at slaughter. The maximum stocking density inside the shed is 27.5 kg/m^2 (or 13 chickens/m^2) and each chicken must have at least 1 square metre of space available outdoors. The indoor environment has natural daylight (windows) and can be enriched with objects. The range area should be covered with living vegetation (such as pasture) and providing overhead shade and shelter (with natural and/or artificial shelters).

Free range broiler house with popholes for access to the outdoor area. Straw is provided for pecking and perching. This type of enrichment is required for farm assurance schemes like *Freedom Food* and *Beter Leven*.

Example of farm assurance schemes: *Freedom Food* (set up by the RSPCA in the UK)[52]. *Beter Leven, 2 stars* (set up by the Dutch animal protection society, de Dierenbescherming, in The Netherlands)[53].

Traditional free range
The chickens are usually of slower growing, more traditional breeds and they will live longer than intensively reared chickens. According to EU marketing standards for poultry meat[54], the maximum stocking density inside the shed should be 25 kg/m^2 (or 12 chickens/m^2).

Example of farm assurance scheme: *Label Rouge* (approved by the French authorities)[55].

Label Rouge bird (has a featherless neck naturally)

Capons
These are heavy breed male birds that are castrated at an early age to allow them to become fatter than a normal male bird. **Castration is performed without any pain relief** and requires **cutting into the abdomen to access the testes.** This causes extreme pain to the bird. While it is banned in the EU, traditional farming systems use a derogation for traditional practices to maintain this practice, such as Label Rouge. It will be labelled as a Capon.

Organic
EU organic standards stipulate that organic chickens should either be reared until they reach the minimum slaughter age of 81 days or else shall come from slow-growing chicken breeds (also reared until 81 days of age)[56]. The maximum stocking density is 21kg/m^2 inside the chicken shed and at least 4/m^2 per bird outside. Organic chickens should have access to an open air area for at least one third of their life and the outdoor range should be covered with vegetation.

Example of farm assurance scheme: *Soil Association* (UK)[57].

Organic broiler sheds on the hillside. Organic typically uses smaller sheds than intensive systems, so smaller flocks with lower stocking densities.

Broiler genetics

Intense genetic selection for growth rate affects the welfare of broiler chickens. Globally, **three major broiler companies dominate the genetics of commercial broiler production** in terms of numbers of animals – these are: Cobb-Vantress, Aviagen and Hubbard[58]. The majority of birds these companies produce are standard broiler chickens.

Farm assurance schemes have played a role in raising consumer awareness about the welfare benefits of slower growing chickens[59]. Slower growth allows the animals developing physiology, to support the increase in body weight and develop greater leg strength. When housed in systems with lower stocking densities, greater leg strength enables the birds to be more active[60]. The global broiler-breeding companies have responded to these customer demands by developing **genetically slower growing birds** (for example CobbSasso and JA757 cross chickens)[61] [62]. These birds grow to live weights of about 2.0 to 3.0 kg in 49 to 81 days depending on the system they are in, thus only gaining less than 48g live weight per day on average.

Slower growing bird breeds include: JA757, CobbSASSO150, Ross Rowan, Hubbard Coloured breeds, all SASSO breeds (*Label rouge*)

Birds should be provided with **optimal environmental conditions** that match their genetic growth rate potential so as not to limit growth. In practice, this means selecting broilers with a genetic growth rate potential that is as closely matched as possible to the time required to reach the desired slaughter weight (and not for example rearing fast growing broilers in a free range system where they will be slaughtered later on)[63]. Adapting birds to their environment requires the broiler industry to test new strains of bird in a variety of environments, including **monitoring of on-farm welfare**, and to include a range of health and welfare parameters in their genetic selection programme[64].

Welfare issues across all broiler systems

- When broilers reach market weight, they must be caught, put into transport crates and transported from the farm where they were reared to a slaughterhouse.

Catching and crating (manual or automatic)

- **One/two leg catching**: The conventional method of catching is manually by teams of catchers. The birds are lifted and inverted and carried by a single or by two legs; three or four birds per hand. This method can severely compromise welfare. Birds experience stress, fear and trauma, especially as broilers are typically unaccustomed to being touched by humans[65]. Catching is also a physically demanding task for the catchers, as they have to work fast and put the birds into packing crates as quickly as possible. This often results in rough handling of the birds, causing physical harm such as bruises, broken bones, dislocated joints and other injuries[66]. Rough handling in combination with the small opening of the transport crates can also lead to bruises or injuries such as broken wings, injuries to the back and thigh or even crushed skulls[67].
- **Whole body catching**: Countries such as Sweden only permit gentle manual catching, where birds are carried upright in pairs. This method causes less stress (lower levels of stress hormones)[68].
- **Automatic 'harvesting'**: Alternatives to conventional manual catching practices have been developed, such as broiler 'harvesting' machines. These automated harvesting systems have long, rotating rubber fingers which gently collect the birds onto a transport belt which then conveys the broilers into the drawers of the transport container system[69]. There currently are a few different catching machines for broilers. Studies that have compared manual catching with mechanical catching, found that automated harvesting systems may lead to lower levels of stress and less (leg) injuries compared to manual catching[70] [71]**.** However, the Swedish gentle manual catching method causes significantly fewer bruises and fractures than mechanical harvesting[72]. There are some disadvantages associated with automated harvesting machines: they can only

be used in larger chicken houses, the costs are higher and the cleaning and disinfection of these machines poses a problem, thus risking farm-to-farm cross contamination[73].

Welfare issues associated with transport

These modules are carrying chickens to a slaughterhouse. This is a typical layout on a lorry.

- **Feed withdrawal:** Before transport to slaughter, broilers are usually deprived of food for several hours, although the EU Broiler Directive stipulates that feed must not be withdrawn from chickens more than 12 hours before the expected slaughter time[74]. Feed withdrawal has been linked to weight loss during transport and has been shown to **cause stress**[75]. Feed withdrawal also **increases the risk of bacterial infection** with *Campylobacter*, a cause of food poisoning which poses a public health concern[76].

- **Space allowance during transport:** Another major stressor during transport is when a large number of birds are put into each transport compartment. This has been shown to raise stress hormones and is also a bigger stressor than food withdrawal before transport and transport itself[77]. **High stocking densities per compartment** also influences the number of birds that are dead-on-arrival (see below)[78].

- **Environmental conditions:** The **micro-environments** prevailing in the transport containers and on the vehicles can cause stress[79]. Therefore it is important that the crates or containers on the truck are secured in place and that there is **sufficient fresh air** for the chickens. On modern poultry transport trucks, protection from adverse weather conditions is provided by sails on the side of the truck[80]. Despite these measures, **cold stress** may occur near the air inlets of the truck and **heat stress** in poorly ventilated areas of the truck during transport[81].

- **Fitness for transport:** Careful inspection of broiler chickens prior to transport is recommended to assess the fitness for transport as birds with **old injuries and/or catching induced injuries**, as well as those with pre-existing pathologies, may be loaded and transported thus posing a risk for **reduced welfare in transport**[82].

- **Dead-on-Arrival (DOA):** Injuries and stress caused by the process of catching, crating and transport can cause the **deaths** of birds upon **arrival at the slaughterhouse**. The most important factors that influence DOA percentage are **stocking densities** per transport compartment (the less space per bird, the more DOA), **transport duration** (the longer the journey, the more DOA), transport **climatic conditions** (rain and wind being associated with more DOA) and **lairage time** (the longer the chickens have to wait to be killed, the more DOA)[83] [84]. These are factors that can be relatively easily managed to reduce DOA percentages. Risk factors such as infectious diseases, heart and circulation disorders and injuries make certain birds more prone to dying during catching and transport[85]. Occasionally high mortalities may occur due to unfavourable circumstances, with DOA figures exceeding 1-2%[86]. This emphasises the importance to **optimise transport conditions**.

- **Time spent in lairage:** On arrival at the slaughter house the chickens normally wait in their transport compartments in a lairage area before being removed from their transport units. The time spent in lairage can be up to several hours and depending on the climate, it may be necessary that the area has climate control. This is especially important in summer time and in (sub)tropical countries in order to reduce thermal stress caused by high temperature and high relative humidity[87].

Welfare issues associated with slaughter

Birds hung consciously by both legs on a shackle line before going through a waterbath for stunning.

Hanging (shackling): Depending on the stunning system (see below), chickens are either hung upside down on a moving processing line with shackles fully conscious (electrical stunning) or unconscious (after gas stunning)[88]. Shackling by the legs is known to be painful and distressing for the birds, so the main welfare concerns associated with shackling are therefore[89]:

- **Bird inversion**: causes stress and wing flapping that can cause injury to the birds;
- **Pain associated with shackling:** due to compression of the leg, differences in leg size, existing leg weakness and injuries;
- **Rough shackling:** inexperienced shacklers, use of excessive force, fast line speed and tight shackle spacing;
- **High lighting levels and noise**: which causes fear in the birds;
- **Shackle line design**: This should be even and without bends or obstructions to reduce stress in birds.

Breast supports can be used to calm the birds and prevent them raising their heads, vocalising or flapping their wings (this will be compulsory from 2019 in the EU)[90].

Stunning
Two different stunning systems are in use[91] [92]:

- **Electrical stunning with a waterbath**: after shackling, the heads of the inverted chickens pass through an electrically-charged waterbath so that high-voltage runs through their bodies which stun them. The depth and duration of unconsciousness depends upon the amount and frequency of currents applied in the waterbath and the current passing through the brain and the resistance experienced. Worldwide, electrical **waterbath stunning is the most common method of stunning** poultry under commercial conditions where large throughput rates (up to 220 birds per min) are required[93]. It requires high standards of technical equipment and skilled people to perform and monitor stunning details such as voltage, current and frequency of the current. Besides shackling, one of the other **main welfare concern** associated with waterbath stunning is the high risk of **pre-stun shocks** that can occur when the bird makes electrical contact with the live waterbath before it is stunned (for example due to poorly designed lines or due to slow line speeds), this will stimulate wing flapping prior to immersion[94]. In addition, struggling birds may receive inadequate current levels or may raise their heads and miss the waterbath altogether, resulting in fully-conscious birds having their throats cut (see below). **Based on the number of welfare issues associated with poultry stunning/killing, scientific opinion recommends that it is phased out** and that systems that cause less stress and pain such as those using gases should only be used[95].

- **Gas stunning (Controlled Atmosphere Stunning or CAS)**: this involves transferring the birds to a controlled atmosphere chamber with gases or gas mixtures (gases permitted are carbon monoxide, carbon dioxide and inert gases such as argon and nitrogen). The birds are thus stunned or killed, depending on the length of exposure to the gases. With **gas stunning methods,** the birds remain in the transport units and pass into the tunnel where they are stunned or the containers are gently tipped so that the chickens slip onto a transport belt which leads into a tunnel with the gas atmosphere[96]. Therefore, gas stunning **eliminates the need for uncrating and shackling** of live chickens, thus avoiding pre-slaughter handling that induces fear, anxiety, distress, suffering or pain in conscious birds. However, the duration of unconsciousness induced with gas stunning is very short and it will be difficult to avoid return of consciousness either prior to or during bleeding. It is therefore **recommended** that all the birds should be killed by the gas mixtures and should not show signs of recovery of consciousness once they have been through the gas chamber[97]**.**

- **Low Atmospheric Pressure System (LAPS):** LAPS killing mimics the physiological effects of ascending to high altitudes. It uses **controlled slow decompression**, which allows the body of the bird to adjust to changes in pressure and thus lose consciousness (from a lack of oxygen) with minimal discomfort[98]. LAPS

has the **potential to improve the welfare** of poultry at slaughter by producing a gradual induction of (non-recoverable) unconsciousness in birds, thereby avoiding the use of potentially aversive gas mixtures, and ensuring every bird is adequately stunned. In addition, this method does not subject the birds to painful pre-slaughter shackling or pre-stunning electric shocks associated with other slaughter methods[99]. In the US, the method has been tested under large scale commercial conditions in order to obtain a 'no-objection' ruling by the United States Department of Agriculture's office of New Technology and it has been in use in a commercial slaughter house since 2011.

Bleeding (killing)
Following stunning, the birds are killed by **cutting a combination of veins/arteries in their necks**, this causes the blood to drain from the body (exsanguination). Bleeding is essential to ensure quick death before recovery could occur[100]. Killing can be done manually or with an automated killer consisting of a rotating knifes that severs the arteries[101].

Religious slaughter
Religious groups have specific requirements with regard to slaughter. According to Halal, Qurrbani/Udhia (Muslim) and Shechita (Jewish - Kosher) slaughter laws, an animal needs to be **slaughtered without prior stunning**. The **welfare concerns** in relation to religious slaughter are that animals that have not been stunned feel extreme pain during the cutting of the throat. In addition, there is a risk that an animal is still conscious despite its throat been cut. During this period, serious welfare problems are highly likely to occur since the animal can suffer, feeling anxiety, pain and distress[102].

- **EU Council Regulation (EC) No 1099/2009** on the protection of animals at the time of killing respects the freedom of religion[103]. The Regulation therefore allows certain '**religious rites**' such as slaughter without stunning for religious communities, however it requires an accurate cut of the throat with a sharp knife to minimise suffering and the slaughter needs to take place in an officially regulated slaughterhouse.
- To give animals that are killed without prior stunning as much **protection** as possible, **immediate post-cut stunning** must be applied in order to protect the animals from unnecessary suffering. Post-cut stunning allows animals to be alive, conscious and healthy at the time their throat is cut (a requirement for religious slaughter), and the blood loss to be as complete as without stunning[104].

Broiler parent birds ('broiler breeders')

The birds that are used to breed chicks that become broiler meat chickens are called **parent birds or broiler breeders**. There are an estimated 75 million breeder birds in Europe[105]. Several practises associated with broiler breeder housing and management give rise to **welfare concerns**[106].

Broiler breeder (parent) birds in indoor shed. Natural mating is often used with about 10% of males to 90% females.

Welfare issues associated with broiler breeders

<u>Mutilations</u>
At the hatchery, besides being **vaccinated**, chicks may also undergo one or more mutilations, such as despurring, detoeing, toe clipping and beak trimming. These procedures have been introduced to reduce injury (such as feather and skin damage) to other birds in the flock. **Beak trimming** (using hot or cold blade or the infrared method) in broiler breeders is carried out without any pain relief to reduce the incidence and severity of feather pecking and cannibalism, and to protect the females from injuries when the male grasps the nape of the hen during mating.

Beak trimming causes pain and distress from handling and from performing the procedure. **De-toeing and de-spurring** are carried out without any pain relief (using a hot blade or hot wire) in order to prevent feather and skin damage and wounds in the hens due to mounting of the male, especially on the back and on the torso beneath the wings. De-spurring may also reduce damage to the males resulting from fighting.

Restrictive feeding

Food restriction is used routinely in the rearing of broiler breeders to limit body weight gain and achieve desired levels of fertility. Feed restriction causes welfare problems associated with **chronic hunger** and leads to **increased competition** around feeding time which may, in turn, lead to injured birds. Feed restriction is practised because if broiler breeders were fed on the same total ration as broiler diets, they would grow too rapidly and become too heavy to maintain good health and fertility before reaching the age of sexual maturity, so instead they receive about 20 – 25% of a standard broilers diet ad lib at certain times. The chronic diet can lead to stereotypic behaviour. Birds begin by pecking at the floor repeatedly, but it can lead to them head pecking that can be so severe it penetrates the brain, with devastating welfare consequences[107].

The feeling of chronic hunger may be alleviated by using diets with a high proportion of **insoluble fibre**, thus improving the welfare of the birds[108]. Another solution to restricted feeding is the use of **alternative genotypes, i.e. dwarf females**. These so-called 'mini-females' have lower feed consumption and feed is almost unrestricted during the production period[109]. The offspring of dwarf females crossed with different types of males, grow slower compared with fast growing broiler breeder offspring, this reduces the risk of health and welfare problems. These hens are used to produce slower growing broiler lines such as for organic or label rouge systems. Mini-hens represent 18-20% of parental stock in Europe and the majority of parental stock in some countries such as France. While the hens are not feed restricted the males are often breeds that still require it. Males make up about 10% of the flock.

Mating behaviour

The percentage of males placed in the production house varies between 7 and 11% of the total flock and in Europe, **natural mating** is the norm. However, this can lead to welfare problems due to **aggression** by males during mating. Inadequate management may lead to males reaching sexual maturity earlier than females. This can lead to **forced copulation**, resulting in distress and injury in the females. Mating can be improved by using lower stocking densities, leading to more appropriate mating behaviour, such as a greater display of **courtship behaviour**, as well as fewer forced matings and less struggling of the hens[110]. Hens can also get better plumage. The use of **environmental enrichment** and barriers for females hide behind can also be used to improve mating behaviour, reducing the frequency of forced matings.

The feeding of broiler breeder (parent) birds is controlled and restricted to manage body weight and sexual activity. The cockerels (right) are fed separately from the females (left).

Nutritional value of higher welfare chicken meat

The **consumption of higher-welfare animal products** in comparison with intensively-produced animal products can have beneficial effects on consumers' health[111]. Consumers who buy animal welfare friendly products also often associate extensive production systems with **healthy, high quality products**. For example, just over 50% of European consumers responding to a survey gave as one of the main reasons as to why they buy products produced in a more animal-friendly way, that they perceived these products to be healthier[112].

- **Fat** is an important source of energy in human diets but excessive fat consumption can contribute to weight gain and associated health problems. For chicken meat, both the rearing system (e.g. free range and organic) and breed (fast, medium or slow growth rates) can significantly **reduce the fat content in tissues such as the breast and legs** (for example see Bogosavljevic-Boskovic (2010)[113] and Castellini (2002)[114]). This reduction in the fat content of meat is most likely caused by the greater opportunity for exercise in alternative systems and in more active (slower growing) breeds with a different morphology so they are not so breast heavy.
- There are also differences between chickens from different systems in the **types of fat** (omega-6 and omega-3 **fatty acids**) in their tissues. Higher-welfare products can have higher levels of omega-3 fatty acids and a more favourable (lower) ratio of omega-6 to omega-3 fatty acids (see for example[115]). These fatty acids play are relevant for a number of **serious diseases**, including cardiovascular disease, cancer, osteoporosis, and inflammatory and autoimmune diseases[116]. The composition of fat in animal tissues, especially with regard to the levels of omega-3 fatty acids, is influenced by the consumption of fresh forage in alternative (extensive) systems.

Choosing higher-welfare chicken meat can make a substantial contribution to meeting healthy diets with low fat intake and achieving a more balanced intake of omega-6 and omega-3 fatty acids, as well as contributing to better welfare for the chickens.

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