Broiler welfare in commercial systems

Animal welfare

The five freedoms (below) define the ideal state for acceptable welfare, and encompass the physical wellbeing of the animal, its ability to perform innate or species-specific behaviours, and its psychological (affective) state. All three components are essential for good animal welfare and are embraced by the World Organisation for Animal Health (OIE, 2011).

1. Freedom from hunger and thirst (via access to fresh water and diet to maintain full health and vigour)
2. Freedom from discomfort (by appropriate environment including shelter and comfortable resting area)
3. Freedom from pain, injury or disease (by prevention or rapid diagnosis and treatment)
4. Freedom to express normal behaviour (by providing sufficient space, proper facilities and company of the animal's own kind)
5. Freedom from fear & distress (by ensuring conditions and care which avoid mental suffering)

Broiler welfare is protected to some degree under EU legislation (Council Directive, 2007), further adoption of that legislation by implementing countries (example, Welfare of Farmed Animals, 2010) and various assurance schemes. The main factors considered likely to improve welfare on-farm are those of stocking density (inclusive of environmental control), growth rate (inclusive of breed suitability), and environmental enrichment.

Stocking density

The negative effects of stocking density on broiler welfare are manifested in relation to poor litter quality, poor walking ability, foot pad dermatitis and behavioural restriction, as reviewed by the European Commission (SCAHAW, 2000). Here they stated 'It is clear from the behaviour and leg disorder studies that stocking density must be 25kg/m^2 or lower for major welfare problems to be largely avoided and that above 30 kg/m^2, even with very good environmental control systems, there is a steep rise in the frequency of serious problems'. EU legislation introduced in 2007 (enforced in 2010), limits maximum stocking density in indoor systems to 33kg/m^2 but allows two derogations; the first to 39kg/m^2 if ammonia, carbon dioxide and extremes of temperature and relative humidity are controlled, and a second to 42 kg/m^2 if accumulative mortality is low (~3.38% at 38days) and demonstrated for seven successive flocks. The welfare of Farmed Animals (England) (Amended) Regulations (2010) limit maximum stocking density to 39kg/m^2 (also adopted by Wales and Scotland); Red Tractor, the industry standard, limits stocking density to 38kg/m^2 whilst RSPCA Freedom Food limits it to 30kg/m^2 with an intermediate growth rate bird. In Europe broilers in standard systems are typically kept at between 18 and 22 birds/m^2, depending on body weight at thinning or depletion.

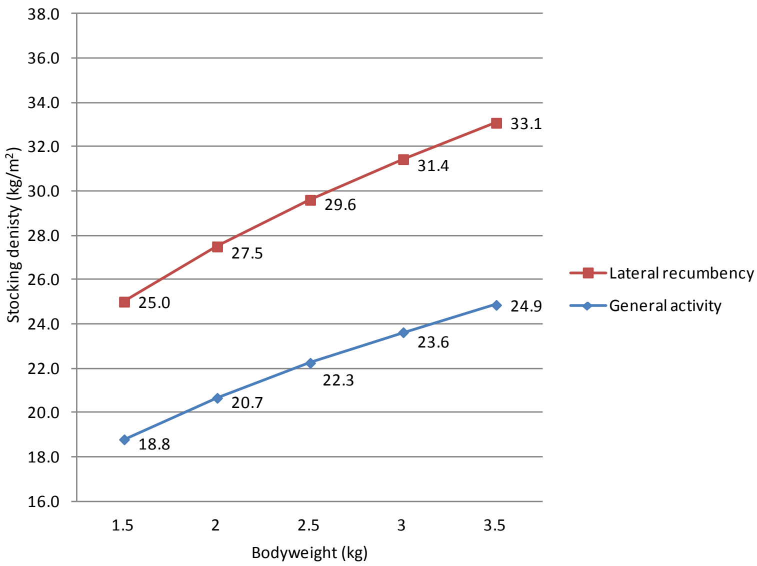
The legislative second derogation to 42 kg/m^2 was clearly detrimental to growth rate and welfare (Dawkins et al., 2004), and increasing stocking density from 30kg/m^2 also led to a deterioration in walking ability and relative humidity in the final production week. Additionally, the negative effects of stocking density on gait (walking ability) produced a 0.013 deterioration in average gait score (see information sheet 4) with every 1kg/m^2 increase in stocking density within the range 15.9-44.8kg/m^2 (Knowles et al., 2008). Environmental control, especially in terms of temperature, relative humidity, ammonia levels and litter quality were of fundamental importance to broiler welfare (Dawkins et al., 2004; Jones et al., 2005); largely indicative of good ventilation.

In reviewing the literature on the effects of stocking density, Estevez (2007) concluded the most severe effects of high density occurred when space availability dropped below 0.07 or 0.065 m^2/bird (assuming 2.5kg liveweight), or approximately 14-16 birds/m^2. This was confirmed by Bokkers et al (2011) in a recent study examining the requirements for static space with limited behaviours. The authors also concluded that further space would be required for more behaviours which would limit the number of birds further.

The static space required by an animal to lie in lateral recumbency or to move between standing and lying is given by the allometric equation $A=0.0457W^{0.67}$ (Petherick, 2007) where A=m^2/bird and W is liveweight. The empirical constant (k) varies according to posture and is not known for general activity. However, using the FAWC (1995) recommendations for turkey stocking density in barn systems (25kg/m^2 for a 5kg turkey) where activity is greater than conventional systems, we can estimate the k value for general activity to be 0.06083. Figure 1 shows the calculated stocking density at given final bodyweights and according to the requirements for lateral recumbency or general activity.

Static requirements vary from 25 to 33kg/m^2 at 1.5 and 3.5kg, respectively, equivalent to 17birds/m^2 at 1.5kg and 9.5birds/m^2 at 3.5kg. Active space requirements vary from 19 to 25kg/m^2 over the same weight range, equivalent to 12.5birds/m^2 at 1.5kg and 7birds/m^2 at 3.5kg. Setting maximum stocking density as a flat rate across the various bodyweights of broilers, leads to overstocking of the lightweight and understocking of the heavy weight birds. Static space for a 2.5kg bird is 30kg/m^2 and is the required density in our Good Chicken Award. Ideally, we would like space allowance (hence calculated stocking density) to be viewed allometrically; as this takes numbers of birds and bodyweight into account.

Figure 1. Maximum stocking density derived from space allowance calculations according to bodyweight and a static or active state.



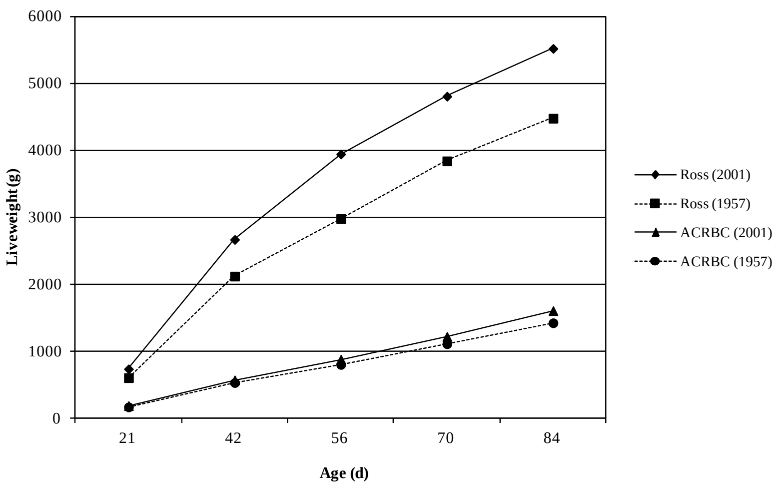
Growth rate

Liveweight and growth rate were entirely responsible for the differences in walking ability of 13 broiler genotypes with a wide range of growth potentials (Kestin et al., 2001). Despite genetic progress for leg health in chickens, poor walking ability is still prevalent though highly variable between flocks, with multi-factorial risks (Bradshaw et al., 2002). Primary risk factors in healthy flocks are those of high growth rate (Knowles et al., 2008) and poor environmental control (Jones et al., 2005). Slowing early growth and increasing activity, via introducing longer dark periods (see below), feeding less nutrient dense diets (Letterier et al., 1998; Welfare Quality, 2010) and feeding mash as opposed to pelleted feed (Brickett et al., 2007a), can improve leg health and walking ability.

As well as improved walking, slow growth potential broilers had significantly less foot pad dermatitis (Nielsen et al., 2003) and are more active, performing more walking, perching and pecking behaviours than fast growth potential breeds (Castellini et al., 2002c; Bokkers and Koene 2003).

Growth rate of the modern broiler is phenomenal, shown in Figure 2, reaching 90 g/d at 42 days (Aviagen, 2009). The Ross bird takes one third of the rearing time (32 days compared to 105 days) and 3 times less feed to produce a 1815 g bird with an FCR (food conversion ratio) of 1.47 compared to a non-selected random bred 1957 bird with an FCR of 4.42 (Havenstein et al., 2003). Genetic selection accounts for 85 to 90 % of the progress with improvements in diet accounting for the remaining 10 to 15 %.

Figure 2. The growth of the modern broiler compared to a 1957 random bred breed (from Havenstein et al., 2003a) fed commercial diets that were typical in 1957 and 2001



Intense genetic selection for high growth rate and breast meat yield with continued improvement in feed efficiency has resulted in a broiler with low activity, and leg, metabolic and physiological disorders such as ascities and sudden death syndrome (SCAHAW, 2000). High growth rate also exacerbates the need for feed restriction and problems of chronic hunger in broiler breeder rearers. Limiting the growth rate potential of a breed (and therefore the level of feed restriction in the parent birds) may be the best practical solution to the welfare problems at the current time. Commercial trials of intermediate (average 45g/d) and fast (average 63g/d) growing breeds reared to 56 and 42 days, respectively, under the same light programme (18 light:6 dark), showed there was less mortality (1.5 compared to 5.6 %), foot pad lesions (12.5 compared to 83.0 %) and hockburn (11.5 compared to 44.9 %) in the intermediate than the fast growth rate birds (Cooper et al., 2008).

The choice of a suitable breed is therefore of primary importance. There are two main global breeding companies delivering highly selected lines of fast growth rate broilers, and one main European company delivering a wide range of alternative growth potentials. Table 1 shows the range of available genetic lines, the choice of which is largely determined by market weight, age and product requirements (portioned, whole carcase etc.). In the UK, the JA 757 and Cobb-Sasso 150 are considered suitable for extensive indoor systems and the Hubbard JA 757 (intermediate GR) is commonly used for organic production. Fast growth breeds, especially the females, may also be used for free range production. Slow growth breeds tend not to be used in the UK, largely because of the small breast conformation and longer time to reach slaughter weight. In France, however, almost 50 % of chicken comes from slower growing breeds and one third from Label Rouge production (Quentin et al., 2005).

Table 1. The genetic potential of current broiler breeds available from three major breeding companies.

Company	System	Breed	35 days			42 days					
			BW (g)	GR(g/d)	FCR	BW(g)	GR (g/d)	FCR			
Ross	**Standard**	308/508/PM3 Arbor Acres Lohman LIR	1918-2021	54.8-57.7	1.58-1.62	2530-2652	60.2-63.1	1.73-1.77			
Cobb		500/700 Cobb-Avian-48	1933-2017	57.0-57.6	1.61-1.65	2548-2626	56.6-62.5	1.76-1.77			
Hubbard		Classic, Hubbard JV, Flex, F15, Yield	1830-2003	52.3-57.2	1.57-1.6	2379-2592	56.6-61.7	1.69-1.74			
			49 days			**56 days**			**70 days**		
			BW	**GR**	**FCR**	**BW**	**GR**	**FCR**	**BW**	**GR**	**FCR**
Ross	Extensive indoor	Rowan	No data available								
Cobb		Cobb-Sasso 150	2110	43.1	1.92	2475	44.2	2.0	3135	44.8	2.23
			BW	**GR**	**FCR**	**BW**	**GR**	**FCR**	**BW**	**GR**	**FCR**
			56 days			**63 days**			**70/77 days**		
Hubbard	Differen-tial	Various (see 1)	1657-2389	29.6-42.7	2.06-2.16	2296-2697	36.4-42.8	2.21-2.31	2215-2651	31.6-37.8	2.37-2.63
	Slow	I657/S757N/ S757/S666 S86							2273	29.5	2.48-2.65

BW: body weight; GR: growth rate; FCR: feed conversion efficiency
1. Progeny from various male crosses with JA57 and Redbro (male and female line) females (examples: Gris Barre (JA) Cou Nu (+/- naked neck), JA957, JA757, New Hampshire, Master Gris, Redpac)
For Ross breeds see: www.aviagen.com/ss/broiler-breeders. For Cobb breeds see: www.cobb-vantress.com/Products/Default.aspx. For Hubbard breeds see: www.hubbardbreeders.com

Environmental enrichment

EU legislation requires broilers to be reared at light levels of 20 lux and provided with a minimum of 6 hours darkness (of which 4 hours are consecutive). Previously, broilers were raised in conditions of 5 lux or less with only 1 hour darkness in each 24 hour cycle.

A period of darkness is required for proper sleep patterns and diurnal behavioural rhythm (Appleby, 1994), and sleep is required for physiological recuperation in terms of energy conservation, tissue regeneration and growth (Malleau et al., 2007). Shorter days improved welfare through fewer skeletal problems (Classen et al., 1991), less mortality (Rozenboim et al., 1999; Bricket et al., 2007b; Schwean Lardner and Classen, 2010), improved walking (Santora et al., 2002; Bricket et al., 2007a; Knowles et al., 2008), and increased behaviour and reduced fearfulness (Sanotra et al., 2002). Based on maximised behavioural expression (increased activity, feeding, drinking, comfort, maintenance and exploratory behaviours) optimal welfare was achieved under a 16 to 17 hour light programme (Schwean-Lardner et al., 2012).

The retina of the avian eye has extensive single and double cones responsible for vision in bright light conditions and is sensitive to the UV-A portion of the spectrum. It is reasonable to assume therefore that bright and natural light is positive for the visual acuity of the birds. Natural light increased the proportion of birds ground pecking (Lewis and O'Connell 2011), and broilers were more active (feed, drink, scratch, forage, walk) (Davis et al., 1999; Blatchford et al., 2009), and preened more (Deep et al., 2012) in environments with higher light intensities. They were more active when the light was stepped-up (Kristensen et al., 2006) and preferred to rest and perch under low light intensity (Davis et al., 1999). Results indicate some form of spatial or temporal distribution of light intensity may benefit welfare by providing periods or areas of activity and rest. Broilers reared at low light intensity (< 5 lux) had heavier and larger eyes than those reared under bright light (Blatchford et al., 2009; Deep et al., 2010 cited in Deep et al., 2012).

Access outdoors allows for foraging and exploration, and increases the range of environments, food sources and activity, creating the potential for improved welfare. Outdoor access increased the activity of fast growth broilers by a factor of 1.8 and reduced rest by 0.8 (Castellini et al., 2002a) and the percent of time spent standing, walking, and pecking was also significantly higher when outdoors than indoors (Jones et al., 2007). On average birds walked 98 strides per walking bout when outdoors compared to 7.2 strides per bout indoors (Jones et al., 2007).

Ranging in fast growth rate breeds, however, is generally low. Studies of large and small commercial flocks found on average 14 % (Dawkins et al., 2003) and 11 % (range 0.2 - 51.4 %, Jones et al., 2007) of birds, respectively, outside near the end of the growth cycle. Slow growth breeds range better than fast, and both ranged more when fed a moderate than low energy diet (Nielsen et al., 2003); slow breeds also spend more of their time outdoors (60 % for Kabir compared to 35% for Ross 208) (Castellini et al., 2002b). Chickens have a diurnal rhythm to their ranging, with more birds outside in the morning and before dusk (Dawkins et al., 2003; Nielsen et al., 2003; Jones et al., 2007). They tend to stay close to the house (Weeks et al., 1994; Christensen et al., 2003) and ranging behaviour, in terms of percent outside and distance covered, increases with age (Mirabito and Lubac 2001; Mirabito et al., 2001; Jones et al., 2007).

Weather and suitability of the outdoor environment greatly affect ranging behaviour. Chickens range more in summer (Jones et al., 2007) and are negatively affected by low temperatures, wind and rain (Gordon and Forbes, 2002). They prefer overcast days, bush and tree cover over short grass (Dawkins et al., 2003); conifer wigwams were also attractive (Gordon and Forbes, 2002). Artificial shelter, outdoor drinkers, and dustbathing areas are required by assurance schemes in an attempt to make the outdoor environment more attractive to the birds. Tree provision with good canopy cover further enhances the outdoor environment and increased the ranging of Label Rouge (Mirabito et al., 2001), and fast growth broilers (Jones et al., 2007).

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