The Impact of Breed on Broiler Welfare – Summary

Most of the modern broiler breeds are the result of decades of genetic selection mainly for fast growth, higher breast yield, leaner meat and lower Feed Conversion Ratio (FCR). This intense selection for performance traits has had negative repercussions on the health and welfare of the birds.

Fast-growing birds have a high basal metabolic rate, and a high energy demand which can create oxygen deficits. This results in ahigh incidence of heart and pulmonary conditions, ascites, and even sudden death. Fast-growing broilers are also prone to leg and foot disorders. These conditions influence their gait score and general activity, causing a poor walking ability, reduced access to feed and water, pain, and inability to perform natural behaviours. Additionally, there is also abundant evidence regarding the prevalence of breast muscle myopathies and skin lesions related to fast growth and high breast yield.

Those painful conditions, added to the inability to perform highly motivated behaviours, often result in chronic stress, which is well known to have a negative effect on the immune system, leading to immunosuppression and an increased vulnerability to disease. Consequently, antibiotic use is significantly higher in fast-growing broilers compared to slower-growing ones (e.g. antibiotic use in Dutch farms using fast-growing broiler breeds was 9 times higher than on farms using slower-growing breeds in 2022). Therefore, using slower-growing breeds with better health and stronger immune systems can significantly contribute to the reduction of antibiotic use in broiler production.

Fast-growing broilers, due to their body conformation and poor health, have difficulties to express natural behaviours such as perching, preening, or exploring. This often translates in an increase in the percentage of time that the birds spend inactive and has a negative effect on their mental welfare. Slower-growing breeds demonstrate a better response to stress than fast-growing ones, are more active and display a larger range of natural behaviours, resulting in a better mental wellbeing overall.

Scientists and animal welfare organizations are calling for the phase out of fast-growing breeds in favour of slower-growing strains selected for better health and welfare outcomes. By signing up to the European Chicken Commitment, companies commit to adopt slower-growing breeds with improved welfare outcomes, offering consumers a higher quality product from healthier, happier chickens.

The Impact of Breed on Broiler Welfare – Scientific Review

Introduction

Most of the modern broiler breeds are the result of decades of genetic selection in order to obtain a fast-growing and higher breast yield chicken. However, this intense selection for performance traits has led to birds with a higher predisposition to diseases (such as acute and chronic heart failure, musculoskeletal deformities, and pathologies) and a poorer immune system, resulting in increased antibiotic use. Some of these pathologies also affect the quality and acceptability of the meat, leading to economic losses and food waste. This document describes the latest research regarding the impact of breed on broilers health, mental welfare (e.g., capacity to cope with stress) and on their ability to express natural behaviours (e.g. enrichment use, activity levels).

There is an urgent need for the industry to move away from these fast-growing breeds and adopt instead breeds able to demonstrate improved welfare outcomes including lower mortality rates, better gait score, and increased activity levels. The European Chicken Commitment, or Better Chicken Commitment (ECC, or BCC) is calling on food companies to adopt a set of criteria to improve the welfare of broilers, including the use of approved breeds with proven higher welfare outcomes.

> "The breeds currently approved under the ECC in Europe are Hubbard Redbro (for indoor use only); Hubbard Norfolk Black, JA757, JACY57, 787, 957, 987, Rambler Ranger, Ranger Classic, and Ranger Gold. Other breeds that meet the criteria of the RSPCA Broiler Breed Welfare Assessment Protocol, the breeds under the Label Rouge certification and other local breeds used in free-range systems with an average growth rate lower than 40g/day, are also accepted."

I. Growth rate and feed efficiency in the modern commercial broiler

The domestic chicken (including the broiler chicken) originates from the red junglefowl (Gallus gallus). Since the 50's, modern breeds have been selected mainly for fast growth, higher breast yield, leaner meat and lower Feed Conversion Ratio (FCR)[1].

In order to illustrate the changes in broiler growth rate in the second half of the 20th century, two meat chicken strains which had been unselected since 1957 and 1978 were grown to 56 days and compared with a modern commercial strain in 2005 (see figure 1)[2]. Between 1957 and 2005, the FCR had decreased by 50% and growth rate had increased by over 400%, with 85–90% of this increase being attributed to genetic selection and the remainder attributed to diet[3]. Similarly in the US, 52 days were necessary to obtain a 2.26 kg liveweight bird in 1992[4], while slaughter weight of 2.5 kg can now be achieved in only 38 days [5].

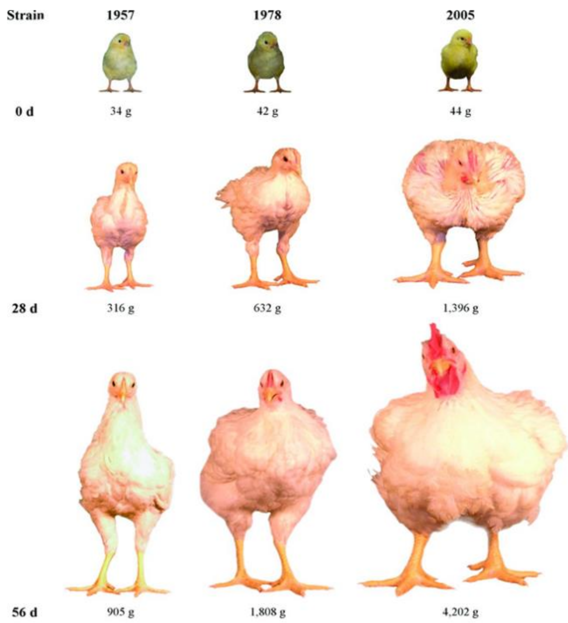

Figure 1. Age-related changes in size of 2 Meat Control strains unselected since 1957 and 1978, and Ross 308 broilers (2005). (from Zuidhof et al., 2014).

Additionally, the conformation of the birds has also changed significantly through selection (Figure 2). For example, breast meat yield continually increased from approximately 15% of the total live weight in 1994 to 25% by 2020[4]. A comparison of slower (Hubbard/ISA) and faster-growing (Cobb 500) breeds showed that slower-growing breeds had a higher carcass yield (70.4 versus 69.9%) and wing fat yield (15.6 versus 14.0%) but a lower breast yield (25.3 versus 26.7%) than fast-growing birds[6]. As more emphasis has been placed on producing meat from the breast, the conformation of chickens has changed and their center of gravity has moved forward, with the consequent changes on the legs' morphology and walking abilities[7].

Poultry meat is the most consumed meat in the word. In Europe, between 2019 and 2021, the average poultry meat consumption was 24.2 kg retail weight per capita[8]. In the US, the average consumption is even higher reaching 49.4 kg per capita. Between 1960 and 2004, the consumer price index for poultry products in the US increased at half the rate of all other products, making chicken meat increasingly more affordable in comparison with other

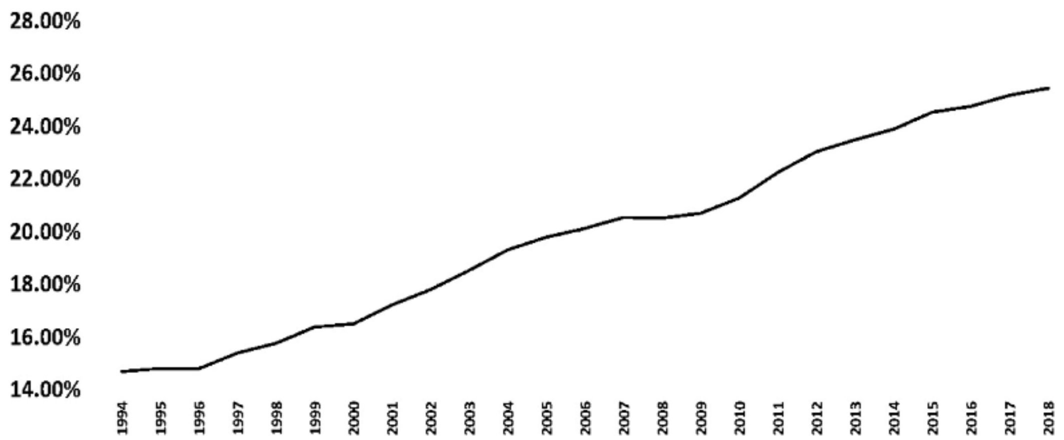

Figure 2: Boneless breast meat yield (% of live weight), 1994 through 2018 in the US broiler industry (From Maharjan et al., 2021).

animal protein sources[2]. While this selection pressure has been successful in providing affordable chicken meat, it also had a number of detrimental consequences for chicken health and welfare, which are detailed in this document and include lower activity, poorer leg health, higher antibiotic usage, musculoskeletal problems (including deep muscle myopathies), metabolic and physiological problems (including ascites), poor immune function, lower mental wellbeing and inability to express meaningful behaviours.

II. Effects of breed on physical wellbeing

1. Heart related conditions

Selection for rapid growth and efficient feed conversion has resulted in birds with a high basal metabolic rate, and a high energy demand which can create oxygen deficits. This high demand of O_2 increases the pressure of the pulmonary artery (condition known as pulmonary arterial hypertension or PAH) and the workload of the heart. This results in the hypertrophy of the right heart ventricle, possibly followed by arrythmia, increased pressure in the thoracic and abdominal cavity, and fluid accumulation in the abdominal cavity (known as ascites) (figure 4)[9,10]. In some cases, arrhythmia can result in ventricular fibrillation and acute heart failure, leading to death (so-called "sudden death syndrome" or SDS)[11].

It can be difficult to accurately estimate the prevalence of conditions such as ascites and SDS due to variation between farms and confidential breeder data. A worldwide survey carried out in 1996 reported an average rate of 4.7% of mortality incidence due to ascites[12] in broilers, and a more recent study reported that mortality rates due to ascites can vary from 5% in broiler flocks to 20% in heavier roaster flocks[9].

Ascites have been observed worldwide in fast-growing broilers, with the rapid growth of modern broilers being identified as one of the major risk factors for the development of this disease[13,14]. In 2020, a study reported an incidence of cardiac arrhythmia of 27% in fast-growing broilers vs only 1% in slow-growing breeds[15]. Mortality due to ascites is also higher in male broiler flocks[16]. Other factors increasing the risk of ascites and/or SDS are high nutritional density, pelleted ration, ad libitum feeding, continuous illumination, and low ambient temperature among others[16].

The risk of heart failure has been associated with both physiological and metabolic mechanisms correlated with fast growth in broiler chickens[17]. In their study, Zhang and colleagues compared the genetic basis of cardiac development and occurrence of heart dysfunction between a modern fast-growing (Ross 708) and a heritage slower-growing (Illinois) broiler, demonstrating that the cardiac development as well as the immune system development were slower in the fast-growing breed. The researchers hypothesized that the greater rate of cells destruction (due to the accumulation of fat) compared with the lower cell proliferation, plus the oxidative stress (usually originating from a high metabolism at cellular level) are the main reasons why these genes were not being expressed in the same way in both breeds, demonstrating a very strong link between fast growth and cardiac and immune system development.

A 2021 study investigating the causes of mortality in six different broiler breeds, showed that only the slow-growing breed (Label Rouge Naked Neck) had a significant lower mortality overall and no deaths due to metabolic diseases compared with the other faster-growing breeds[16] (Figure 3). A different study[6] compared two broiler breeds: the slower-growing I957 (Hubbard/ISA) and the fast-growing Cobb500. They reported an overall mortality of 5.6% in the fast-growing strain, including 2.1% caused by heart and circulation problems. Mortality in the slow-growing strain was 1.5%, including 0.4% caused by heart problems.

Mortality	AA	AF	CO	HU	IS	RO	LR
Total							
n	26	14	29	24	26	35	5
Percentage[1]	9.63	5.19	10.74	8.89	9.63	12.96	1.85
AS[2]							
n	13	3	15	11	15	12	0
Percentage	4.81	1.11	5.55	4.07	5.56	4.44	0.00
Percentage/Total	50.00	21.43	51.72	45.83	57.69	34.29	0.00
SDS[3]							
n	6	4	7	5	8	7	0
Percentage	2.22	1.48	2.59	1.85	2.96	2.59	0.00
Percentage/Total	23.07	28.57	24.14	20.83	30.77	20.00	0.00
Others[4]							
n	7	7	7	8	3	16	5
Percentage	2.59	2.59	2.59	2.96	1.11	5.92	1.85
Percentage/Total	26.93	50.00	24.14	33.34	11.54	45.71	100.00

[1]270 initial birds per strain.
[2]Ascites syndrome.
[3]Sudden death syndrome.
[4]Including culled birds.

Figure 3: Causes of death in different broiler strains: Arbor Acres (AA), Avian Farms (AF), Cobb-500 (CO), Hubbard (HU), ISA (IS), Ross (RO), and Label Rouge (LR) male broilers (from Gonzales et al, 2021)

2. Locomotory disorders

Fast-growing broilers are prone to leg and foot disorders, including bacterial chondronecrosis with osteomyelitis, angular bone deformity, femoral bone degeneration, hock burn and foot pad dermatitis. These conditions influence their gait score and general activity, causing a poor walking ability, reduced access to feed and water, pain, and inability to perform natural behaviours[15]. Although there are several factors associated with poor leg health and impaired locomotion in broilers, growth rate and genotype have been identified as the most important ones[18]. Research has shown that slower-growing broiler hybrids (with a growth rate of less than 50 g/day[19,20]) have lower risks of developing locomotor problems as compared to fast-growing hybrids[20,21].

Musculoskeletal disorders

Bacterial chondronecrosis with osteomyelitis (BCO) has been reported to be the most common cause of severe leg health issues in broiler chickens, although the information available on this condition is limited[22,23]. An Australian study involving 20 commercial broiler farms found BCO lesions in 28% of necropsied birds (including culls and mortalities)[24]. BCO occurs due to the formation of microfractures caused by the rapid growth of the bones. This fast growth provokes a local ischemia that favours opportunistic bacteria proliferation[13] (Figure 4). The shift in the centre of gravity associated with the disproportionate growth of the pectoral muscles leads to a higher development of the femur, making this bone particularly prone to BCO[23].

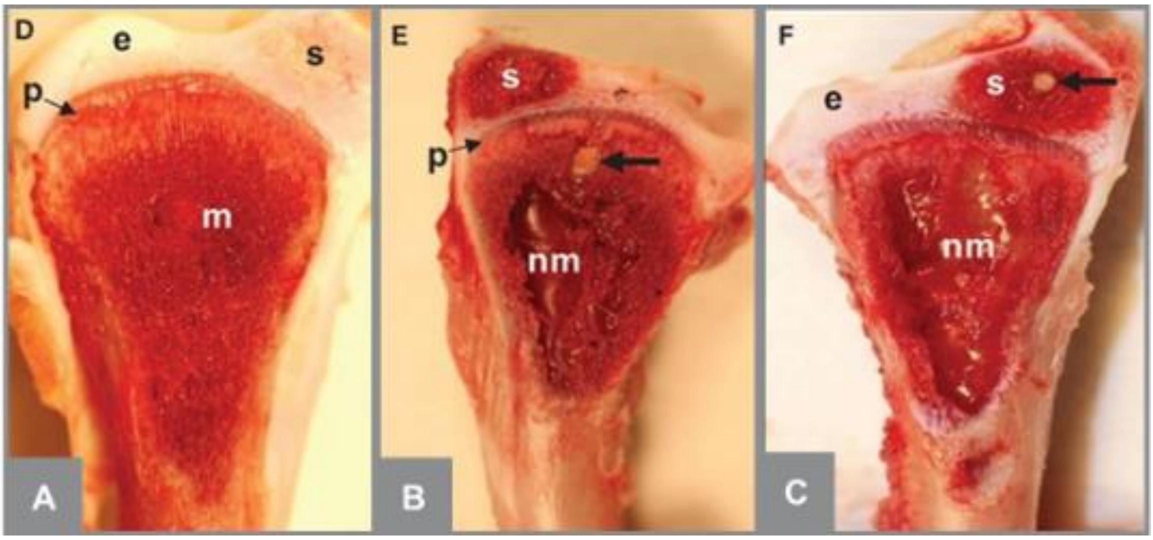

Figure 4: Normal tibial head (A). Bacterial infection has destroyed a portion of the growth plate (B, C). Thick arrows point to bacterial colonies (from Wideman and Prisby, 2013).

There is also a genetic basis for the presence of bone and leg deformities in broilers (Figure 5). Leg deformations are abnormalities of the growth cartilage that results in deformed bones and, at least in severe cases, causes walking impairment. They include tibial dyschondroplasia, rotated tibia and valgus-varus deformity[25]. Rapid gain weight at early stages is one of the main factors associated with the presence of these deformities [26,27]. The incorporation of health and welfare traits in the selection program of the breeding companies has decreased but not eliminated the occurrence of these conditions [25,28].

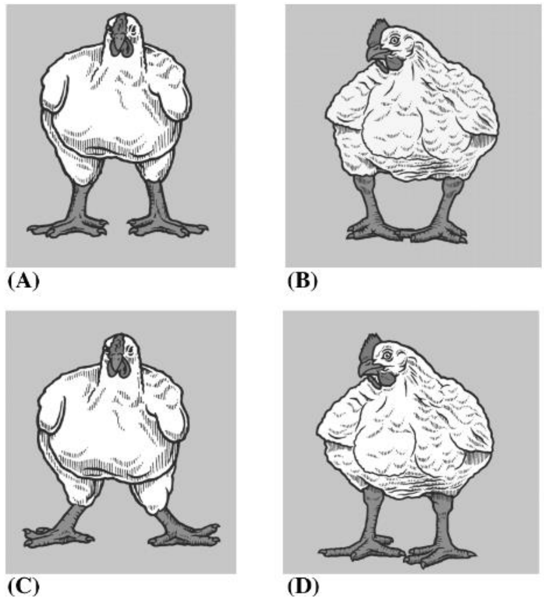

Figure 5: Examples of a normal chicken (A) and chickens with three deformities: (B) Bowed-out, (C) Bowed-in, (D) Rotated (from Siegel et al., 2019).

Foot and leg contact dermatitis

Contact dermatitis is the inflammation of the subcutaneous tissue leading to hyperkeratosis, necrosis or ulcerations which are painful for the birds[25]. Footpad dermatitis (FPD), which affects the foot and toe pads, and hock burn (HB), which affects the caudal part of the hock joint, are two very common and painful conditions affecting broiler chickens. They are frequently used as welfare indicators, normally by scoring the lesions using a 5-point score scale[29].

Several factors are known to influence the incidence of FPD and HB, related to the quality of the housing environment – in particular litter quality and stocking density, as well as the genetics used. Lower and less severe presence of FPD and HB in slower-growing breeds have been reported in several recent studies[20,21,30]. For example, a 2020 study determined that the prevalence of HB (score 1 or 2) was higher in faster-growing broiler chickens at high stocking density compared to slower-growing broilers at low and high stocking density[21]. The prevalence of FPD (score 1–3) was 7% in fast-growing broilers at high stocking density compared with 1% in slower-growing broilers at low stocking density. Improved FPD and HB scores were also found in the slower-growing JA757 compared to three fast-growing breeds (Ross 308, Cobb 500 and Hubbard Flex) housed at the same stocking density (8.5 birds/m^2)[20] and a different study reported that fast-growing birds were 53.2% more likely to develop HB than slow-growing birds at the same stocking density (29 kg/m^2)[31].

Walking ability

All the aforementioned conditions, aggravated by the unbalanced body conformation of the modern broiler's body[32], are often associated with poor walking ability. Walking ability is commonly assessed using a six-point scoring system known as the Bristol or Kestin scale[33].

Numerous studies comparing the walking ability of fast and slower-growing breeds have been published in the last three decades[15]. For example, a 2019 study[34] showed that the Ross 308 strain (FG) had a significantly poorer walking ability, leading to a higher percentage of culls due to leg weakness compared to the Rowan Ranger (SG), with 8.8% of the Ross birds suffering from lameness (gait score 2-5 on the Bristol scale) at week 6 compared with 0.3% of the Rowan Ranger birds. The slow-growing JA757 also presented a significantly higher percentage of birds with better gait scores compared with three fast-growing breeds (Ross 308, Cobb 500, Hubbard Flex) at a stocking density of 8.5 birds/m^2 (18.7 kg/m^2) (Figure 6)[20].

Both breed and stocking density, and their interactions, have been shown to have a significant effect on walking ability. For example, Rayner et al. (2020) found that faster-growing broilers (63 g/d) reared at 34 kg/m^2 had more birds scoring greater than 3 in the Bristol Gait Score compared to 2 slower-growing breeds (ADG: 45 and 49g/day) at different stocking densities: 30 and 34kg/m^2 (Figure 7)[21].

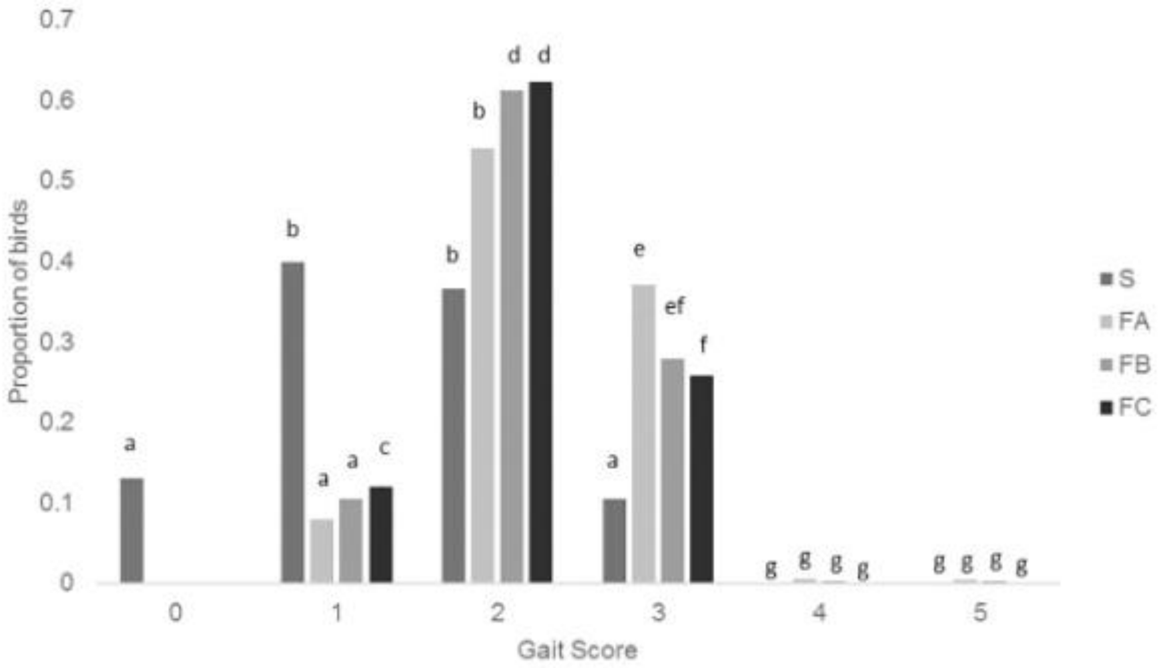

Figure 6: Mean proportions of each gait score for Hubbard JA757 (S) and 3 fast-growing breeds anonymised (Ross 308, Cobb 500, Hubbard Flex). Different letters denote significant differences (from Dixon et al, 2020).

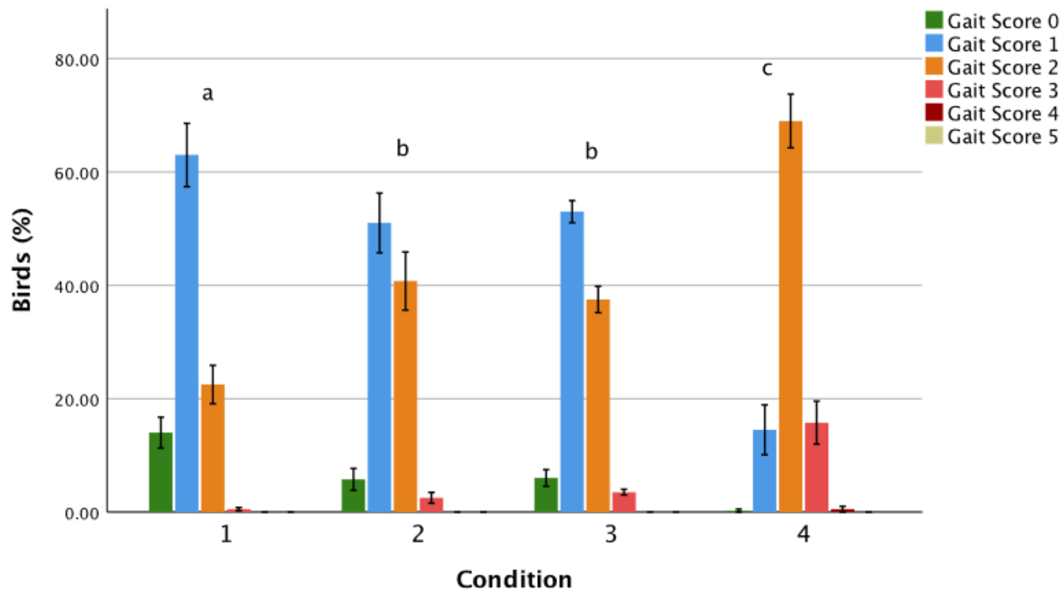

Figure 7: Mean (± SE) percentage of birds with each Gait Score (ranging from 0, walks with ease, to 5, unable to walk) in 4 different strains (from Rayner et al., 2020).
1= SG Breed A (GR 45g/day); S.D: 30kg/m2. 2= SG Breed B (GR: 49g/day); S.D.: 30kg/m2.
3= SG Breed B (GR 49g/day); S.D.: 34kg/m^2. 4= FG Breed C (GR 63g/day); S.D.: 34 kg/m^2.

3. Skin and muscle

The most frequent conditions affecting the skin of the birds are scratches, as well as problems affecting the skin of the breast, such as blisters (bursitis), buttons (dermatitis) or burns on the breast (inflammation). They are less frequent than dermatitis affecting the feet, but more serious from an economic point of view, as they lead to the discarding of the carcass. These problems develop when the birds have frequent contact with moist material. This is favoured by poor plumage conditions, poor litter quality and low activity levels[25]. Research has often shown that faster-growing birds have a higher prevalence of breast irritation and skin lessions[6,35]. Differences in feather quality and activity levels between FG and SG breeds may explain this higher prevalence, as they spend more time lying or sitting in contact with the litter, which can causes irritations to the skin and increases the prevalence of contact dermatitis[25].

There is also abundant evidence regarding the prevalence of breast muscle myopathies related with fast growth and high breast yield[36,37]. Fast growth and selection for higher muscle yield are believed to play a central role in the recent increase in these myopathies in modern broilers, affecting mainly the breast muscles Pectoralis major and Pectoralis minor. Selection pressure for fast growth and high breast yield have altered the birds' metabolism and muscular structure, leading to the disruption or malfunction in the structure, metabolism, or repair mechanisms of the breast muscle tissue[38]. This translates into economic losses and food waste due to carcass condemnations and negatively impact animal health and welfare.

For more information on the consequences of selection for fast growth and muscle yield, please consult our public resource: Current meat quality issues for broiler chickens.

4. Internal Infections: Gastro-enteric disorders

Infections of the viscera (for example, heart, liver, lung and intestine) occur in broiler flocks with variable frequency. Among those, gastro-enteric infectious diseases are considered a highly relevant welfare issue for commercial broilers[25]. The incidence of enteritis in poultry can be influenced by different factors such as the rearing environment, the genetics or the diet. Additionally, there are numerous pathogens that can disturb the intestinal homeostasis.

Commercial fast-growing broiler lines were mainly selected for growth performance traits and often exhibit sub-optimal microbiota compared to slower-growing chickens. Slower-growing broilers possess a healthier gut due to a more diverse microbial community with higher levels of healthy microbiota[25,39].

Regarding specific pathogens, two studies[40,41] have compared the susceptibility of fast and slow-growing strains to *Campylobacter* infection. While Gormely and colleagues[40] found no differences in caecal load at 42 days between birds of different genotypes, Humphrey and colleagues[41] found a prolonged inflammatory response in one of the FG breeds, with evidence of damage to gut mucosa and diarrhoea.

A recent study has also showed that the slower-growing Redbro was more resilient to a *Salmonella Typhimurium* infection and showed greater early life immune protection compared to the Ross 308[42].

5. Organ size

Modern strains of broilers have significantly smaller organs (as a percentage of body weight) and larger carcasses compared to 1957 strains[3,43]. For example, Rothschild and colleagues[44] used a sub-sample of strains of a bigger trial from Guelph University, which included a conventional strain C (GR 66g/day), and 3 slower strains M, H and D (GR 54, 50 and 46 g/day, respectively). At target weight of 2kg live weight, the fast-growing strain C presented significantly smaller lungs and kidneys than the other breeds. Smaller organs may negatively impact welfare by reducing functional capacity, leading to conditions that results in a negative affective state such as pain, malaise or even breathlessness[45]. For example, a 2018 study showed that, when exposed to the same temperatures, a slow-growing 1972 strain of

Ross showed less panting than the 2004 Ross 308[46]. The lack of oxygenation can also lead to an increase in myopathies such as woody breast and white stripping[47].

More research is needed to study the possible link between organ size, lack of muscle oxygenation and muscle pathologies in broilers, as well as the impact of breathlessness on their welfare.

6. Immunocompetence and antibiotic use

It has been evidenced that selecting animals for fast growth has a negative effect on their immune function[48]. Additionally, due to their fast metabolism and body conformation, fast-growing chickens often suffer from health issues that can cause pain and discomfort, such as contact dermatitis and leg deformities. Those painful conditions, added to the inability to perform highly motivated behaviours often results in chronic stress[49], which is well known to have a negative effect on the immune system, leading to immunosuppression and an increased vulnerability to disease[50,51].

Giles and colleagues [52] investigated the immune response of fast-growing (Ross 308) and slower-growing (Ranger Classic) broilers to *Eimeria maxima* infection and compared their relative potential for resistance to coccidiosis. They concluded that the immune response of the slower-growing breed was better than the fast-growing one and that was linked to less elimination of oocysts (hence reducing the contamination of the environment with pathogens) from the slower-growing breed.

The rise of antibiotic-resistant pathogens and the need to reduce the use of antibiotics is a hot topic for human, animal, and environmental health. Using slower-growing breeds with better health and stronger immune systems contributes to the reduction of antibiotic use. A 2021 analysis of the different Dutch broiler production systems found a positive synergy between the use of slower-growing breeds and the reduced use of antibiotics[53]. More recently the Dutch authority for the responsible use of antibiotics in animals has published data on antibiotic use in Dutch broiler farms in 2022, demonstrating an antibiotic use 9 times lower in farms where slower-growing breeds of broilers were used compared to farms with fast-growing birds[54] (Figure 8). Farms with slower-growing breeds had an average of 1.4 annual defined daily doses for animal per farm ($DDDA_F$) compared to 12.4 for the conventional broiler farms.

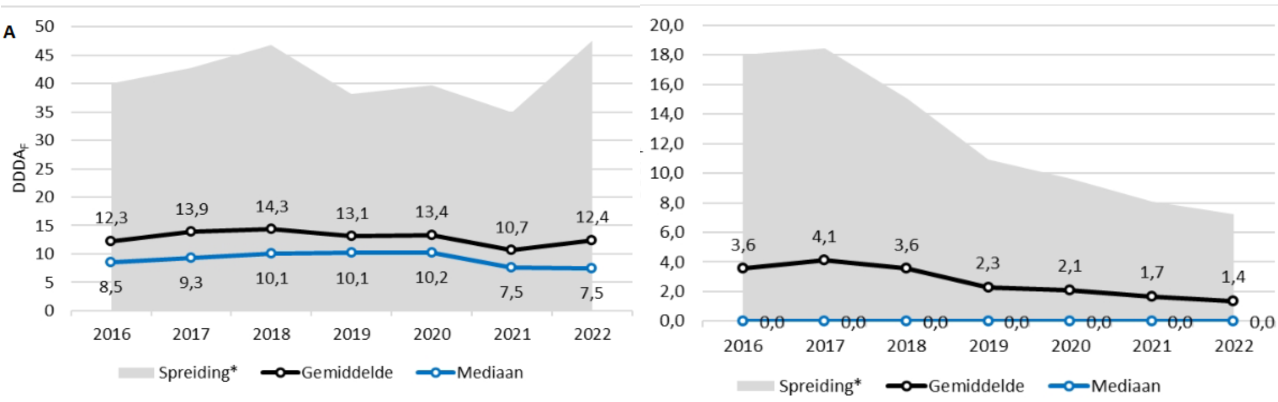

Figure 8: Long-term trend of DDDAF (defined daily dose of antimicrobials for animal per farm) with (A) regular broilers and (B) slower-growing broilers in The Netherlands. Shown are mean (gemiddelde) and median (median) DDDAF, and dispersion (spreading) (SDA autoriteit Diergeneesmiddelen).

III. Effects of breed on mental welfare

The mental state of the animal is increasingly seen as the key determinant of welfare. Sentience and the ability to suffer is the main reason for public concern about welfare, and it is increasingly understood that both biological functioning and the ability to express behavioural preferences influence, and are influenced by, an animal's mental state[55]. The response to stress and the capacity to cope with stress are good indicators of an animal's mental state.

Castellini and colleagues[56] tested the suitability of 8 breeds to an organic rearing system: 3 slow-growing breeds (GR<24g/day); 4 with intermediate growth (24<GR<=40g/d) and 1 fast-growing (GR>41g/day), by looking at several indicators including behaviour, fear (tonic immobility) and stress (heterophil/lymphocyte ratio and percentage of eosinophils in the blood) indicators. Slower-growing breeds demonstrated a better response to stress than the fast-growing breed, presenting a lower heterophil/lymphocyte ratio and a higher retention of eosinophils in the blood. Slower-growing breeds also presented a lower mean duration of TI (38 to 62 seconds) compared to the fast growth breed (126 sec), indicating a lower fear response and better resistance to stress. A different study also using TI to compare the fear response of different breeds reported that the duration of TI in fast-growing Cobb Sasso T88 (50.08 sec) and Cobb-500 (52.97 sec) was significantly longer compared to the slow-growing Rhode Island Red (28.77 sec)[30].

Other fear tests such as avoidance and novel object tests have been used to compare different breeds with conflicting results. However, these tests can be confounded by the motivation or walking ability of the chickens, which is often altered in fast-growing breeds[57,58].

Another novel method to assess the mental wellbeing of farm animals is the Qualitative Behaviour Assessment (QBA)[59]. Although this method is still not frequently used in broiler chickens, it is included in the Welfare Quality Network assessment for broilers[29]. In their 2020 study comparing breeds with different average growth rates (AGR) at different stocking densities, Rayner et al. performed a QBA and found significant differences in one of the components. The only fast-growing breed (AGR 63g/day) was found significantly more likely to be "Flat/Stressed" and less "Happy/Active", indicating a more negative emotional state that the rest of the birds (Figure 9)[21].

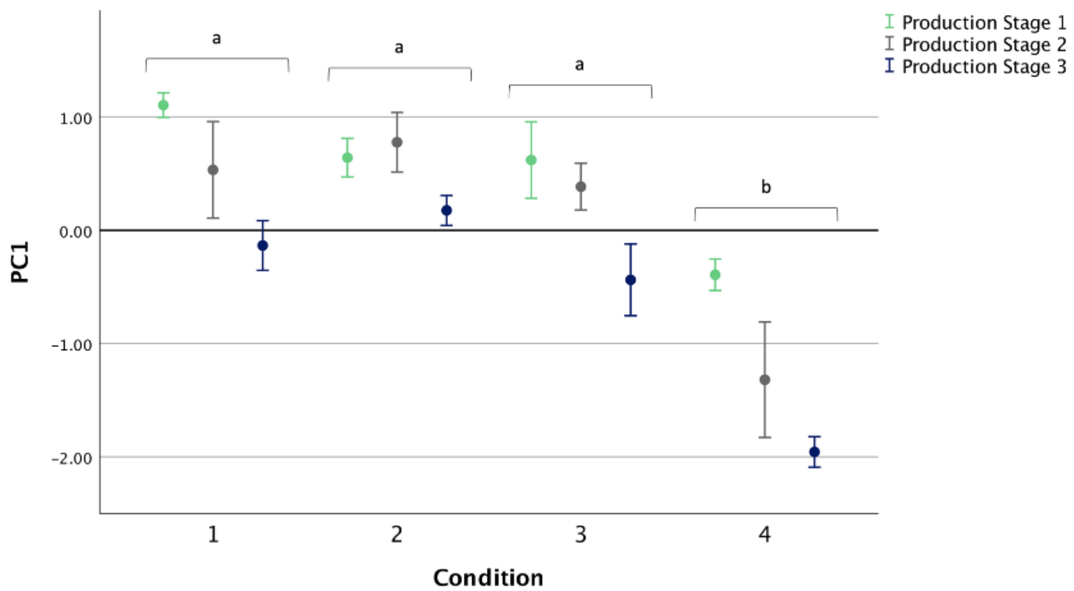

Figure 9: Mean (± SE) Qualitative Behaviour Assessment principal component (PC) scores for Principal Component 1, which ranged from 'Happy/Active' (high scores) to 'Flat/Stressed' (low scores) (from Rayner et al.2020)
1= SG Breed A (AGR 45 g/day); S.D: 30kg/m2. 2= SG Breed B (AGR: 49g/day); S.D.: 30kg/m2. 3= SG Breed B (AGR 49g/day); S.D.: 34kg/m^2. 4= FG Breed C (AGR 63g/day); S.D.: 34 kg/m^2.

IV. Effects of breed on natural behaviour expression

Modern chicken descends from the wild red junglefowl. Despite intensive selection for improved productivity, the broiler chicken has retained a number of behavioural needs, i.e., behaviours that the chicken is highly motivated to perform, regardless of its environment[60]. Broiler mental welfare is improved when they are provided with opportunities to engage in behaviours that are important to them and are physically able to do so (i.e., movement not impaired due to pain, oversized body, or unbalanced conformation). Fast growth rate can impair the ability of broilers to express their natural behaviours such as perching, preening, pecking, wing flapping or dustbathing[61–64]. This often translates in an increase in the percentage of time that the birds spend inactive[5].

A 2016 study measured the birds' activity (time spent outdoors, moving and resting) as well as their engagement in comfort behaviours, such as preening, dustbathing and wing/leg stretching (Figure 10)[61]. Three slower-growing breeds (Ancona, Leghorn and a crossbreed Cornish x Leghorn; AGR < 24 g/day), 4 breeds categorised as medium-growing (Gaina, Robusta Maculata, Kabirand, Naked Neck; 25 < AGR ≤ 40 g/d) and one fast-growing (Ross 308; AGR > 41 g/d;) were kept in indoor pens (0.1m2/bird) and given access to and outdoors paddock (4m2/bird) from the age of 21d. Slower-growing breeds moved on average 42% of the time, compared with only 7% in the fast-growing breed. Moreover, slower-growing breeds rested on average 39% of the time, compared to the fast-growing breed that rested on average more than half of the total time (55%). Slower-growing breeds also walked a longer distance from the house (14.7 m) than the fast-growing breed (4.9 m). Finally, the fast-growing breed engaged significantly less in comfort behaviours (0.5% of their time in average) than the slower-and medium-growing breeds (2.0-3.2%).

		L	A	CL	G	RM	K	NN	R	χ^2
Initial interest[1]	%	65^{c}	62^{c}	60^{c}	45^{ab}	50^{b}	45^{ab}	55^{b}	30^{a}	0.25
Time spent outdoor	% of total time	60^{d}	62^{d}	56^{c}	46^{bc}	49^{bc}	42^{b}	55^{c}	19^{a}	15
Distance from house	m	18.1^{c}	17.5^{c}	15.3^{bc}	11.6^{b}	15.3^{b}	11.2^{b}	14.5^{bc}	4.9^{a}	12.4
Eating	%	3.6^{a}	2.1^{a}	3.6^{a}	33.2^{c}	4.5^{a}	18.4^{b}	19.4^{b}	37.0^{c}	13.2
Moving	"	71.5^{d}	51.2^{c}	50.6^{c}	25.4^{b}	40.6^{bc}	20.3^{b}	35.0^{b}	7.0^{a}	34.1
Resting	"	21.6^{a}	34.3^{ab}	34.9^{ab}	40.0^{ab}	37.3^{ab}	60.2^{c}	45.0^{ab}	55.5^{bc}	25.1
Comfort	"	2.0^{ab}	3.0^{b}	3.2^{b}	0.2^{a}	3.1^{b}	1.0^{ab}	0.2^{a}	0.5^{a}	2.1
Other behaviour	"	1.2^{b}	9.3^{c}	7.4^{c}	1.0^{b}	14.2^{d}	0.0^{a}	0.0^{a}	0.0^{a}	4.2

N: five birds/four replications per genotype.
L, Leghorn; A, Ancona; CL, crossbreed Cornish × Leghorn; G, Gaina; RM, Robusta Maculata; K, Kabir; NN, Nacked Neck; R, Ross.
$^{a...d}$Values within a row with different superscripts differ significantly at $p < 0.05$.
[1]Interest shown by the birds towards the observer on the first 5 min of the presence in pen.

Figure 10: Ethogram and time budget (%) of different broiler breeds (from Castellini et al. 2016) Slower-growing: L, A, CL; Medium-growing: G, RM, K, NN; Fast-growing: R

Another study from 2020[20] compared, among other parameters, the behaviour of three fast-growing breeds (Ross 308, Cobb 500 and Hubbard Flex) and one slow-growing (Hubbard JA757). Compared to the fast-growing breed, the JA757 spent less time feeding, drinking and sitting, and more time engaging in active behaviours such as locomotion, foraging, preening, dustbathing, and perching. Despite of the lower amount of time spent feeding, the slower-growing breed consumed more feed overall and grew meeting the breed standards.

The higher activity level and the higher time spent engaging in natural behaviours in slow-growing birds have been reported in several additional studies. In a recent study by Baxter and colleagues, slower-growing Redbro birds performed more play behaviours and spent a significantly higher amount of time perching compared to Ross 308[5] (Figure 11).

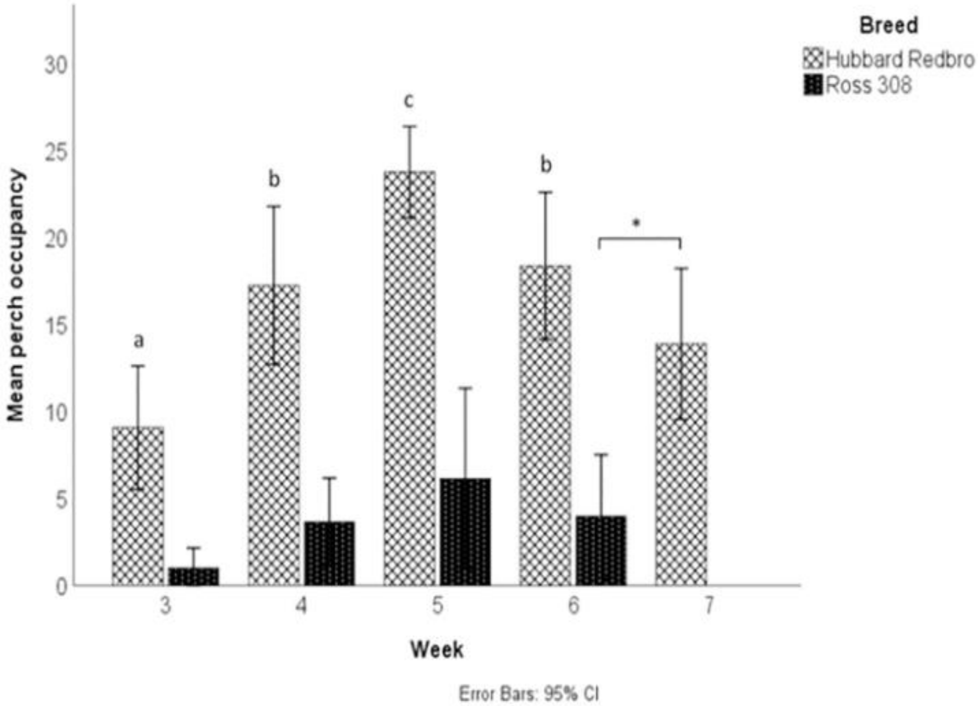

Figure 11: Perch occupancy results for Redbro and Ross 308 broiler chickens. Mean number of broilers on top of the platform perch, by week and breed (Baxter et al. 2021).

Additionally, slow-growing birds use the environmental enrichment, in particular perching space, more frequently[19]. Fast-growing breeds lack the physical ability to jump up and balance on perches, so are only able to use narrow perches until 2 weeks of age and wider platforms until 4-5 weeks of age. However, even when provided with platforms, FG chicken flocks will only spend one quarter of the amount of time perching in comparison to flocks of SG breeds. In contrast, SG chickens are bred for higher welfare outcomes, and use perches and platforms significantly more throughout their lives, illustrating some of the health and mobility issues faced by the current FG breeds[20,21]. For example, a 2021 study showed that faster growing birds (Ross 308) reduce or stop the use of platforms with age, when they become too heavy. Contrarily slower-growing Lohmann Dual chickens showed higher usage from the eighth week of life[65].

V. Conclusion

Modern broiler breeds are the result of a genetic selection based mostly on maximizing growth rate and meat, especially breast, yield. However, this selection has produced birds that suffer from numerous health issues such as musculoskeletal, cardiovascular, and metabolic conditions, reduced walking ability, reduced organ size or immunosuppression. Additionally, these birds present higher levels of stress and fear than slower-growing breeds and engage less in natural behaviours such as perching, preening or exploring, spending longer periods of time inactive. This not only has repercussions on the physical and mental welfare of the birds but can also often negatively affect meat quality, resulting in economic losses and food waste.

Scientists and animal welfare organizations are calling for the phase out of these fast-growing breeds in favour of slower-growing strains selected for better health and welfare outcomes. Genetic selection has recently been identified in the 2023 EFSA opinion *Welfare of broilers on farm* as the main cause of welfare concerns in the poultry industry. The report states that the health and welfare status of broilers mainly depends on the genetics used, which are associated with more than half of the welfare issues that affect broiler chickens on farm and recommends "*selecting for more robust breeds with ameliorated abilities to cope with the management systems in use and/or the use of slower-growing hybrids, with particular attention to breeds with lower mortality, reduced leg weakness and reduced susceptibility to cardiovascular diseases*"[25].

By signing up to the European Chicken Commitment, companies commit to phase out fast-growing breeds and adopt instead slower-growing breeds able to demonstrate better welfare outcomes, offering consumers a higher quality product from healthier, happier chickens, decreasing at the same time antibiotic use and food waste in their supply chain.

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