Towards One Hundred Percent Organic:

Research and development to achieve a one hundred percent organic ration for the Sheepdrove poultry system: Trial 1

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Final Report
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Sheepdrove Organic Farm

ELM FARM RESEARCH CENTRE

1. Executive summary

- This final report summarises the results of the first trial of the work in relation to 'breed and feed' trials.
- The trial was undertaken to investigate the impact of removing the Soil Association derogation for 20 per cent non-organic component in organic table bird feed ration.
- The trial also investigated the suitability of the ISA 257 breed currently used in the SOF system, as it has been questioned as to whether it is the most appropriate genotype to use.
- The objectives of the trial were to compare a one hundred percent organic ration with Sheepdrove's usual eighty percent ration, and the usual ISA 257 breed with the Colourpac bird. In addition to establish the impact of the above regimes on the agronomic and economic factors in the system, including bird weight, dressed weight, carcase downgrading conditions and feed consumption and costing, and to ascertain the impact of the regimes on the health, welfare and behavioural factors.
- Two batches of 2000 birds were grown in identical houses divided into sections in mixed flocks of approximately 500, under organic free-range conditions conforming to Soil Association standards.
- Weekly weights were obtained for 50-bird samples of each genotype and ration combination in each flock/house, as were behavioural observations after week 6.
- Gait scoring was undertaken one week prior to depletion for a sample of birds of each genotype and ration combination in each flock/house.
- At slaughter, on-line flapping, feather damage, bird cleanliness, contact dermatitis, carcase weight, carcase bruising, wing haemorrhages, damage to the skin and carcase conformation scores were collected for a sample of 51 birds of each genotype and ration combination from each flock/house.
- The trial indicated a small statistical difference in the live and carcase weights between the two rations, with the 100 percent producing slightly lower average weights. In practice and in the context of the soon to be removed derogation this difference is minimal. This difference is further reduced, as the trial did not identify an economic shortfall in producing birds on the 100 percent ration.
- In addition, the trial did not identity any overall health, growth or welfare implications, or any behavioural differences, in the birds the four regimes (ISA and Colourpac on the 80 percent organic ration, and ISA and Colourpac on the 100 percent organic ration). This was despite an initial suggestion that a nutritional inadequacy in the 100 percent organic ration may cause differences to be apparent.
- There were some differences between the two strains of bird ISA 257 birds were found to be significantly less clean, had more feather damage and back bruising than Colourpac birds. However these were generally at low levels overall, and despite these findings, the ISA 257 was found to have better carcase conformation when compared with the Colourpac.
- The trial highlights footpad dermatitis as a possible welfare concern, as footpad dermatitis was found to be at high levels relative to conventional broiler systems across all the regimes. It is possible this is due to litter condition. This indicates that foot condition within the Sheepdrove system should be monitored.
- Wing haemorrhage and red wing tips were significantly more prevalent in ISA 257 birds than Colourpacs. This is not the result of more severe flapping, as ISA 257 flapped significantly less than Colourpac birds, so this could be the result of a difference in bird robustness. This merits further investigation.
- In conclusion, on the basis of the trial, there appears to be no implication in moving to the 100 percent ration when required to do so. It should be considered that the finding could be an artefact of the summer weather; so further study should investigate the same regime with the winter season.
- Further study should also consider other 100 per cent ration formulations.

2. Introduction

2.1. The Sheepdrove Organic Farm (SOF) silvo-poultry system established in 2002 currently raises ISA 257 bird on an eighty percent organic ration.

2.2. The use of this eighty percent organic ration is permitted under the Soil Association's organic certification of broiler chickens (table birds) feed derogation. This allows the use of up to a twenty percent non-organic component in the feed ration. This derogation will be removed in August 2005.

2.3. The current derogation, allowing a twenty percent non-organic component in table bird feed ration, exists, due to concerns that a ration without this component would not meet the birds nutritional needs and therefore compromise their health, welfare and growth.

2.4. The primary concern relates to amino acid levels and, in particular, methionine. Methionine is important for bird growth and is currently supplied in ration for the most part through the non-organic twenty percent.

2.5. A further concern is the perception that the ingredients currently used to supply methionine do not have a suitable organic substitute.

2.6. Finally there are fears that moving to a wholly organic ration will increase the cost of production, through increased feed cost, and reduced bird performance. This will impact on finances negatively, in a system that already operates within a very narrow market requirement.

2.7. The ISA 257 breed is acquired from an organic parent flock but the body shape and lineage of the bird is essentially that of a slow growing conventional broiler.

2.8. It has been questioned whether the genetic base of this bird, currently used in the SOF system, is the most appropriate bird for an organic table bird system, being essentially a slow growing conventional broiler. However, working within the tight constraints dictated by the market for weight and conformation, there is limited availability of alternative breeds in the numbers required by SOF for production.

2.9. One alternative strain that fits the market requirements and is available in the numbers required is the Colourpac. The Colourpac shares a parent with the ISA 257 and will enable a potentially beneficial change to be made without moving too far from the market expectations.

3. Objectives

3.1. The trial compared a one hundred percent organic ration with Sheepdrove's usual eighty percent ration, and the usual ISA 257 breed with the Colourpac bird.

3.2. The trial established the impact of the four regimes (ISA and Colourpac on the 80 percent organic ration, and ISA and Colourpac on the 100 percent organic ration) on the agronomic and economic factors in the system, including bird weight, dressed weight, carcase downgrading conditions and feed consumption and costing, and ascertained their impact.

3.3. It also established the impact of the four regimes on the health, welfare and behavioural factors in the system.

4. Approaches

4.1. The data was collected on two batches of birds over the periods March to May and April to June 2004.

4.2. For each batch of birds the following procedures were undertaken:

4.2.1. The two breeds of birds were grown under organic free-range conditions conforming to Soil Association standards, in mixed flocks, of 500 birds, containing equal numbers of each breed.

4.2.2. Birds were housed in two identical brooder houses, with one house fed on an eighty percent organic ration and the other on one hundred percent organic ration, both with starter crumb and finisher pellet components (see appendix 1, and appendix 2 protocol A).

4.2.3. The eighty percent ration used was the current production ration used in the Sheepdrove system, and the same feed company formulated the one hundred percent ration. The nutrient formulation of the one hundred percent ration was prepared so that it was as similar as possible to the eighty percent ration. In some cases this was difficult to achieve due to the lack of suitable organic substitutes for some ingredients and some compromises were made (see appendix 1 and 2 for ration formulations).

4.2.4. Fifty birds of each genotype, from each brooder, were weighed on arrival and then each week whilst in the brooder sheds (see appendix 2, protocol B).

4.2.5. The birds from the brooder sheds were divided between two field sheds ("Top" and "Bottom") in the same field (see appendix 2, protocol C). The birds from each shed were divided in two, with their own separate ranging areas, to create four groups. The treatments were replicated in the second house but were reversed in terms of house end.

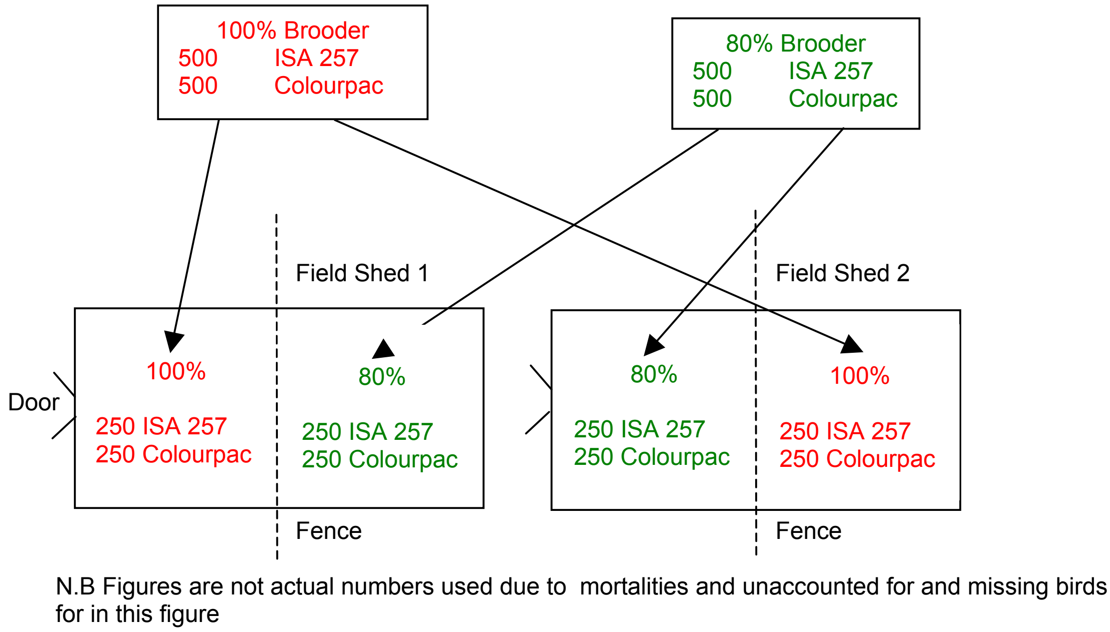

Figure 1a: Division of birds from brooder to field sheds

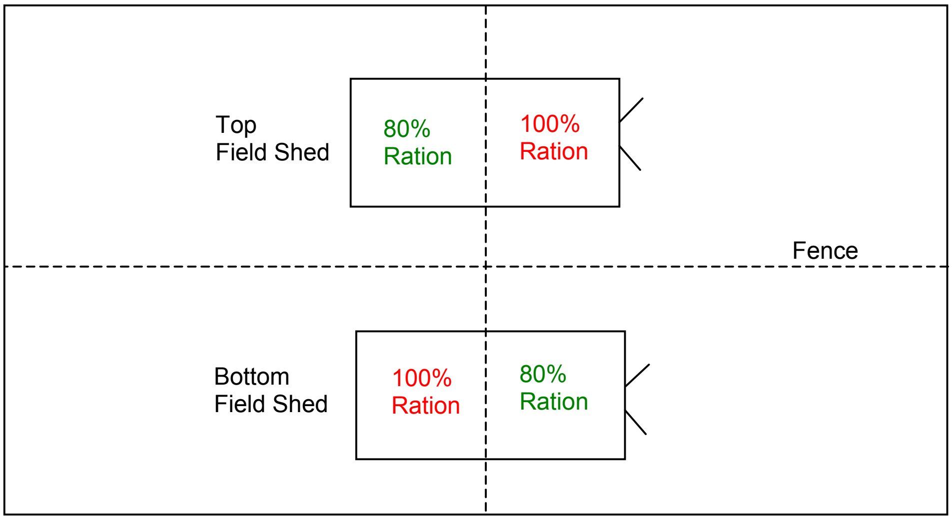

Figure 1b: Layout of trial sheds within field.

4.2.6. Whilst in the field sheds, fifty birds of each genotype from each group were weighed each week, and one day prior to slaughter (see appendix 2, protocol D). The data for bird weights was analysed and mean values produced for each week, and at slaughter.

4.2.7. Behavioural observations of the birds were undertaken weekly, after week six (see appendix 2, protocol E, for descriptions and appendix 3 for a full ethogram).

4.2.8. Gait scoring of the birds was undertaken in week nine, one week prior to slaughter (see appendix 2 and protocol F), using the scoring system from Kestin *et al*. (1992).

4.2.9. Feed consumption, of both starter crumb and finisher, was recorded for each ration type in each shed.

4.2.10. Birds from each shed were slaughtered on separate days (4 days of processing in total), due to restrictions on the number of birds that could go through the processing plant in one day. On each day a sub-sample of fifty one birds from each ration and genotype treatment were caught at random (see appendix 2, protocol G) so they could be followed in treatment groups throughout processing. This sub-sample was taken, as all of the birds were unable to be sorted by genotype and ration type due to the pressure this would have created on processing and catching staff.

4.2.11. On each slaughter day the four groups of genotype and ration were processed consecutively (see appendix 2, protocol H).

4.2.12. Flapping was assessed for the second batch of birds only, and was done immediately post hanging on line (see appendix 4). Feather pecking, bird cleanliness, contact dermatitis (foot burn) and hock burn were assessed on line (see appendix 4).

4.2.13. Carcases were weighed and inspected for bruising (fresh and old), wing haemorrhages red wing tips, damage to the skin (breast blisters and other blemishes and subjectively scored for conformation (see appendix 4).

5. Results and Discussion

Agronomic and Economic Factors

5.1. Bird Live weight

5.1.1. Bird live weights can be seen in table 1 and are illustrated as a growth curve in figure 2.

	Weekly Average Weight (g)			
	80% ration		100% ration	
Age	ISA 257	Colourpac	ISA 257	Colourpac
Day Old	45.82	44.79	45.91	44.80
Wk 1	117.89	122.84	103.90	109.87
Wk 2	264.99	271.75	215.87	240.34
Wk 3	438.99	443.20	356.81	392.67
Wk 4	630.08	645.29	512.77	583.33
Wk 5	907.72	960.63	780.14	861.73
Wk 6	1240.31	1276.25	1064.22	1140.24
Wk 7	1431.49	1552.05	1314.42	1423.85
Wk 8	1872.39	1910.03	1758.76	1817.69
Wk 9	2186.24	2225.54	2048.13	2104.10
Wk 10	2483.66	2460.98	2339.91	2375.45

Table 1: Weekly average weights (g) of ISA 257 and Colourpac birds on 80 percent and 100 percent organic rations.

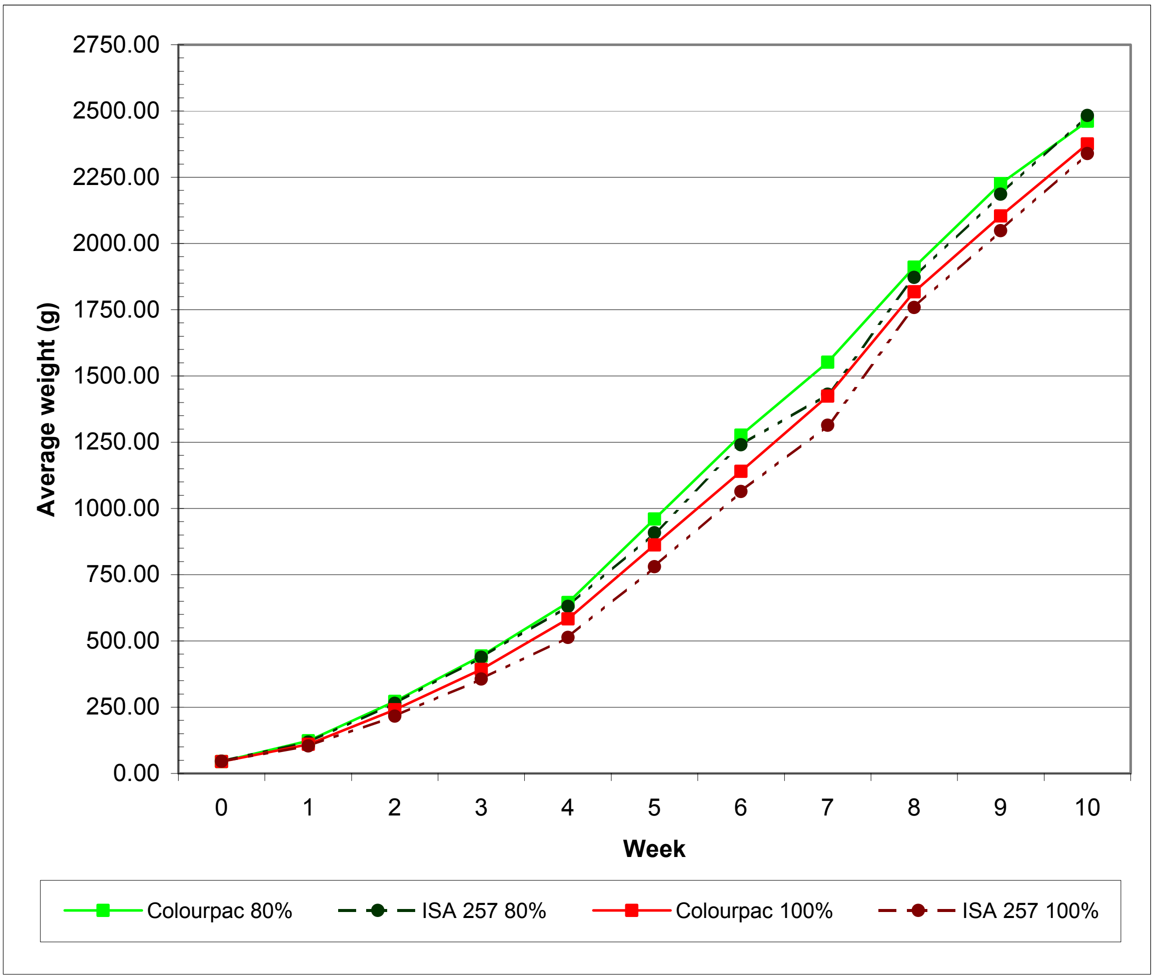

Figure 2: Weekly average weights (g) of ISA 257 and Colourpac birds on 80 percent and 100 percent organic rations.

5.1.2. A hierarchical model was used to test for significant differences in final live weights. There was no significant difference in final live weights between the two genotypes. There was however, a statistically significant difference between the two ration types ($p<0.05$) with a significantly lower average weight for the birds on one hundred percent ration; with an average difference 114 grams, this is demonstrated in figure 2.

5.1.3. Figure 3 demonstrates that the population distribution for both genotypes on the two ration types were of similar shape and range with the target live weight marked.

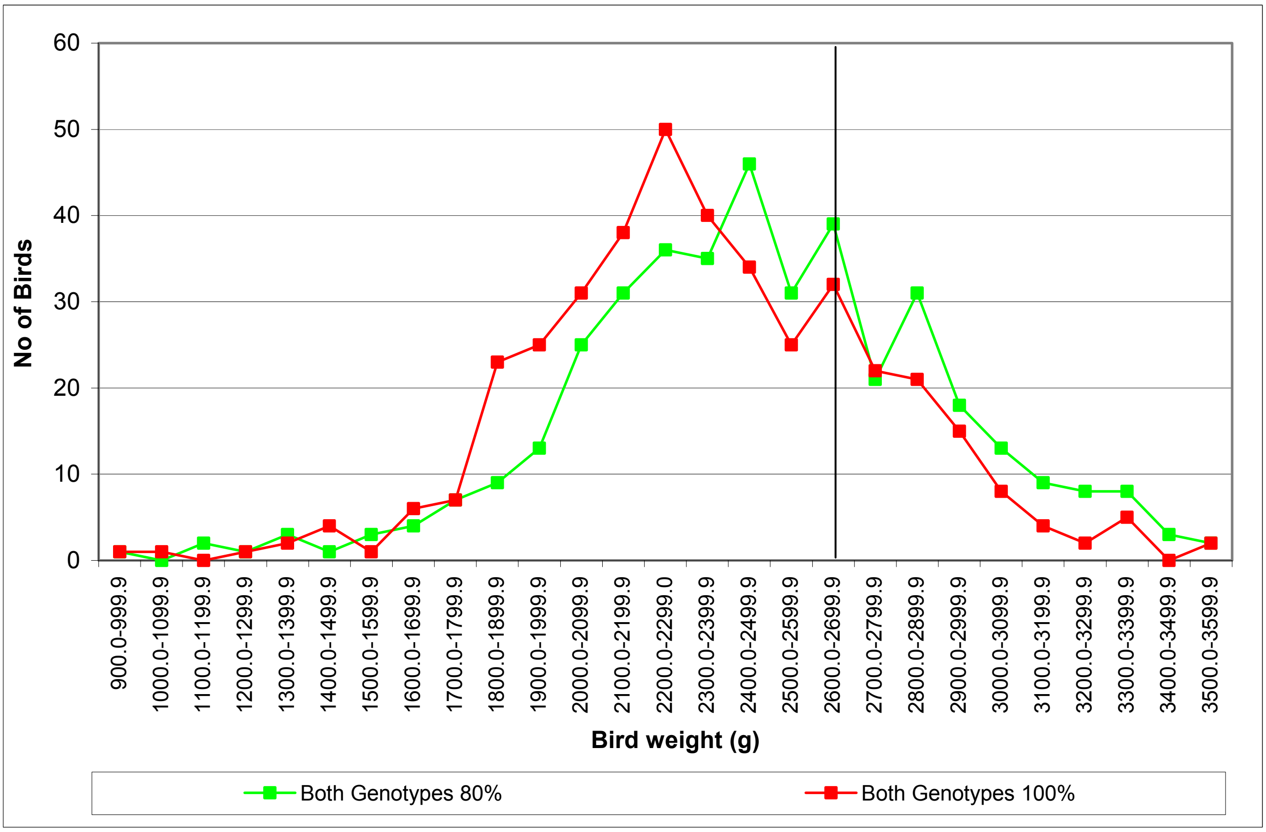

Figure 3: Population distribution, day 69/70 and 72, both genotypes on 80 percent and 100 percent organic rations.

5.1.4. This difference in the final average live weights could be due to the difference in nutritional composition of the two rations (see appendix 1).

5.1.5. Even though there is a statistically significant difference in the live weights between the ration types, the actual difference in the means is very small 114g. In practice, based on the evidence gathered at this point, in terms of bird welfare and production, and monetary return the difference is minimal. The similarities in the population distributions and ranges of weights for the two genotypes (see figure 3) are more striking.

5.2. Dressed carcase weight

5.2.1. For dressed carcase weights see table 2.

5.2.2. A hierarchical model was used to test for significant differences in dressed carcase weights. There was a statistically significant difference between the two genotypes ($p<0.05$) with a significantly higher average dressed carcase weight for Colourpac birds, (an average difference of 37 g). There was also a statistically significant difference between the two ration types ($p<0.05$) with a significantly lower average weight for the birds on one hundred percent ration (an average difference 65 g).

Dressed carcase weights	80% Ration		100% Ration	
	Top Shed	Bottom Shed	Top Shed	Bottom Shed
ISA 257	1630.90	1616.20	1566.20	1489.96
Colourpac	1654.94	1656.59	1587.57	1583.29

Table 2: Average dressed carcase weights (g) of the ISA 257 and Colourpac in the two sheds and the 80 percent and 100 percent organic rations.

5.2.3. As with live weight, even though there is a statistically significant difference in the dressed carcase weights between the ration types and genotypes, the actual difference in the averages is very small. It suggests that, in practice, very similar performance regardless of ration type or genotype.

5.2.4. This is an indication that in 'real' systems terms the similarity of the performance of the rations and genotypes is more notable than the difference.

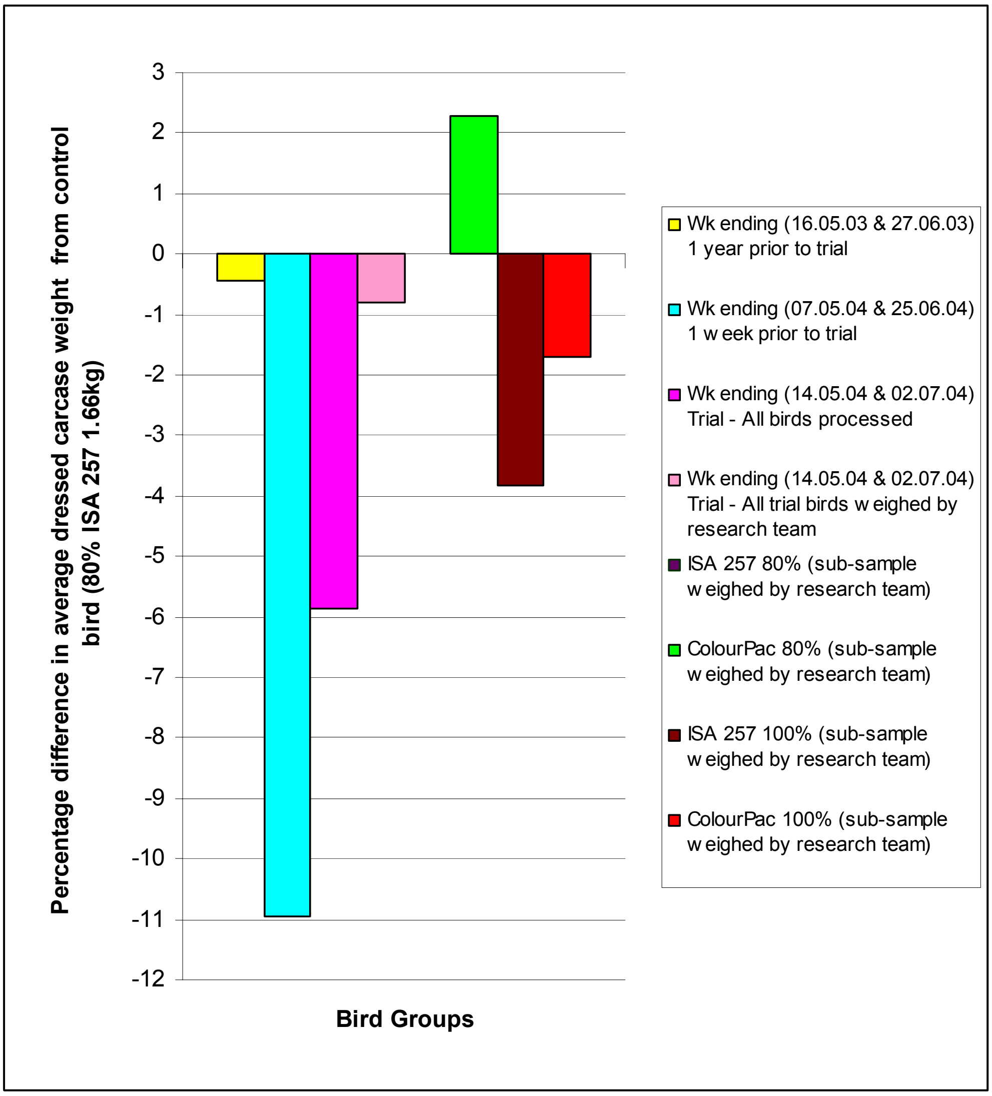

Figure 4: Comparisons of average dressed carcase weight (kg) for trial birds (All birds, genotype and ration type groups) the production birds of the previous week, and the week equivalent to the trial of the previous year.

5.2.5. Figure 4 demonstrates that the average dressed carcase weight for the trial birds, as a whole group, was slightly lower than that of the production birds of the previous week and year.

5.2.6. However, when considering genotype and ration type the dressed carcase weights are slightly higher than that of the production birds for both genotypes on the eighty percent ration.

5.3. Yield

5.3.1. There were slight differences in total yield, i.e. percentage of live weight converted to dressed carcase weight, for the different genotypes and ration types. The results suggest a marginally better yield for Colourpac birds than ISA 257s. With a greater conversion for birds on the one hundred percent ration. However, only a very small difference in yield (three percent range) was noted between the genotypes and ration types.

5.3.2. However, this measurement of yield considers the whole carcase, and not carcase composition, which is more relevant to production output. It is suggested that future studies should consider carcase composition enabling detailed investigating of how ration type affects the composition of the two genotypes. This was not possible in the current trial due to constraints on time and personnel and working with production birds required for sale.

5.4. Potentially carcase downgrading conditions

5.4.1. For scores of potentially carcase-downgrading conditions see table 3.

5.4.2. There were no significant differences between the two genotypes in potentially carcase downgrading conditions, including skin blemishes, breast blisters, and breast and leg bruising. These conditions were low in prevalence.

5.4.3. A statistically significant difference was found in levels of back bruising between the two genotypes ($p=0.001$). The finding suggests more severe back bruising in ISA 257 birds (see table 3).

5.4.4. Back bruising has been suggested to be caused by the height of the pop holes, as it only occurred severely in the second batch of birds and low pop holes were observed on a number of occasions in this trial. This is however anecdotal.

5.4.5. If this is the case, as the two genotypes are of similar weight and therefore size when alive and would have equal opportunity to be affected by the pophole height, it may be that the ISA 257 birds are less robust than Colourpac birds.

5.4.6. There was a significantly higher prevalence of red wing tips and wing haemorrhaging in the ISA 257 birds when compared with the Colourpac birds ($p<0.001$) (see table 3 and figure 5).

Condition	ISA 257 80% ration	Colourpac 80% ration	ISA 257 100% ration	Colourpac 100% ration
Breast Blister 0-2 scale (*increasing severity*)	0.010	0.059	0.044	0.035
Skin Blemish 0-2 scale (*increasing severity*)	0.020	0.039	0.044	0.035
Back Bruising 0-2 scale (*increasing severity*)	0.620	0.255	0.480	0.366
Breast Bruising 0-2 scale (*increasing severity*)	0.005	0.020	0.015	0.000
Leg Bruising 0-2 scale (*increasing severity*)	0.005	0.010	0.010	0.000
Red Wing Tips 0-2 scale (*increasing severity*)	0.436	0.162	0.422	0.134
Wing Haemorrhage 0-2 scale (*increasing severity*)	0.074	0.049	0.127	0.015
Conformation 0-3 scale (*increasing quality*)	1.671	1.464	1.660	1.576

Table 3. Effect of genotype and ration type on average scores for potentially carcase downgrading conditions and conformation dermatitis.

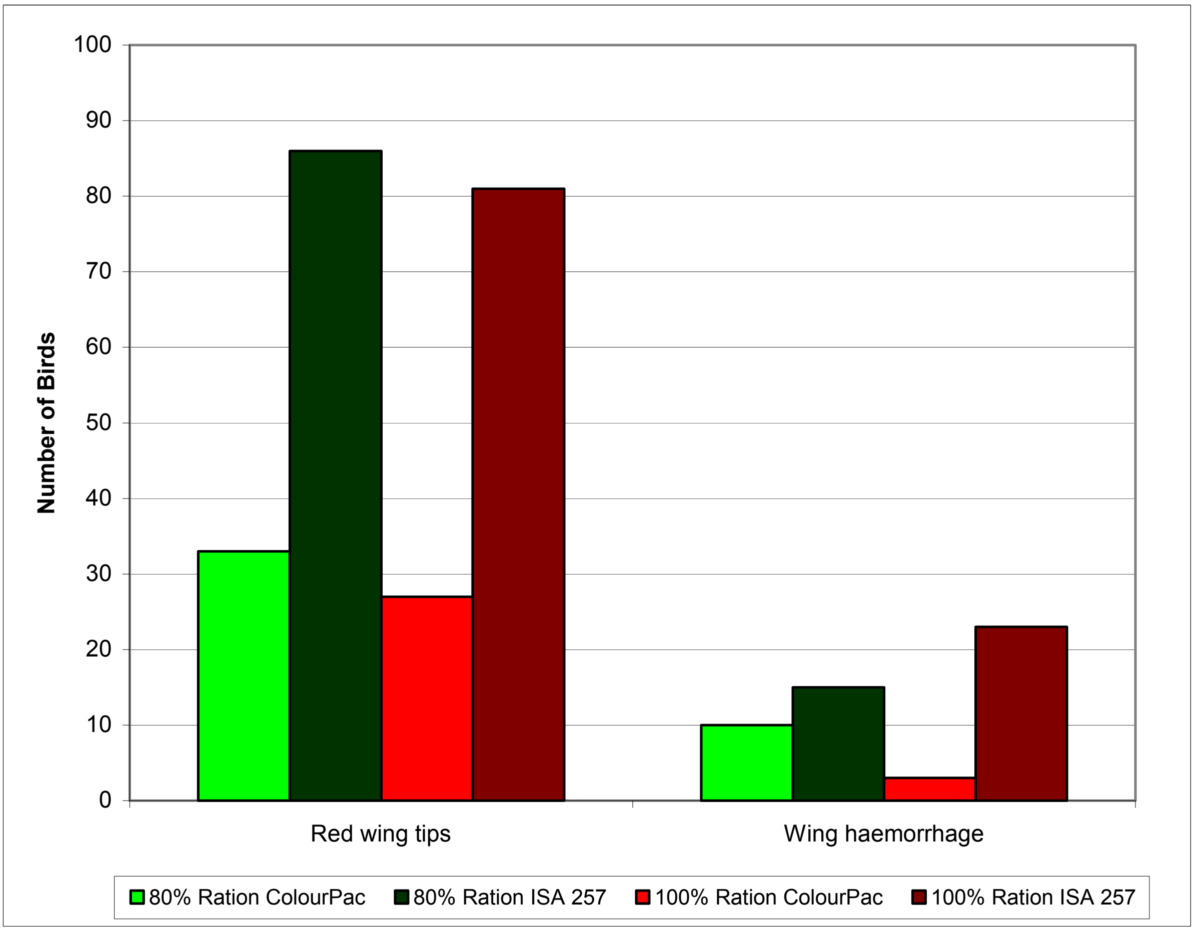

Figure 5. Prevalence of red wing tip and wing haemorrhage in ISA 257 and Colourpac birds on 80 and 100 percent organic rations.

5.4.7. A statistically significant correlation was found between red wing tips and wing haemorrhage (r=0.101, n=812, p=0.004).

5.4.8. This finding is not what would be expected when examining the differences in wing damage as this (red wing tips and wing haemorrhages) is more prevalent in ISA 257 birds and not as the flapping scores would suggest in Colourpac birds (see 'health welfare and behavioural factors'). It is possible this is due to the small size of the data set, or that on-line flapping is not the cause of red wing tips and wing haemorrhages but this is more the result of flapping and damage at catching.

5.4.9. Alternatively this could be the result of a real difference in the general robustness of the two genotypes, with ISA 257 flapping less (see below) but being a less robust bird and more easily damaged. Anecdotal evidence suggests that this could be the case as over the course of the trial it has been noted that Colourpac birds tend to flap and be more 'skittish' when being handled.

5.4.10. This finding should be investigated further over the course of future trials.

5.4.11. A statistically significant difference in conformation scores was found between the two genotypes (p=0.034), the finding suggests better conformation for ISA 257 birds, (see figure 6), but this is not entirely clear.

This could be due to the small size of the data set, as conformation scores were not collected for all processing days, due to resource constraints.

5.4.12. It is difficult to say clearly that ISA 257 birds had 'better conformation' as conformation scoring is very subjective. To be more certain of this result I would want to investigate this on a number of occasions. This would, if this result were found repeatedly, help validate the above finding.

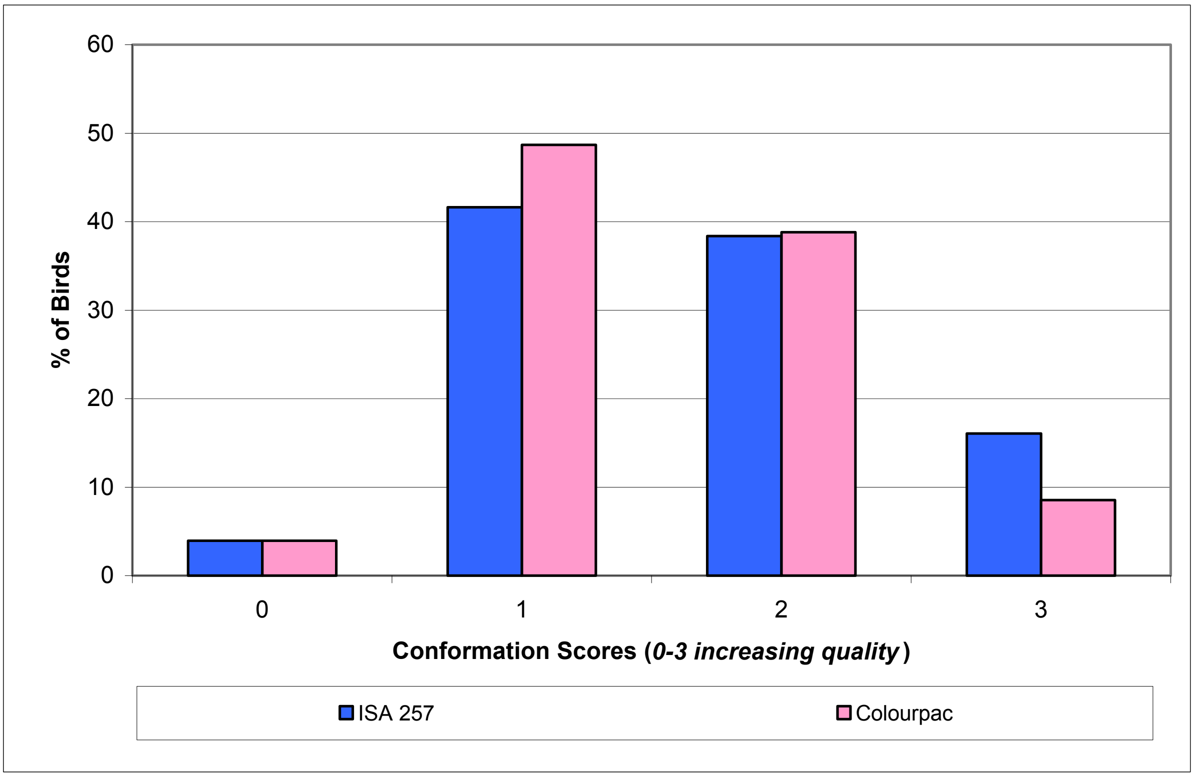

Figure 6: Conformation scores for both genotypes.

5.5. Feed Consumption

5.5.1. There was a difference in feed consumption between the two rations when considering both batches of birds, with a trend for a lower consumption on the one hundred percent organic ration (see figure 7).

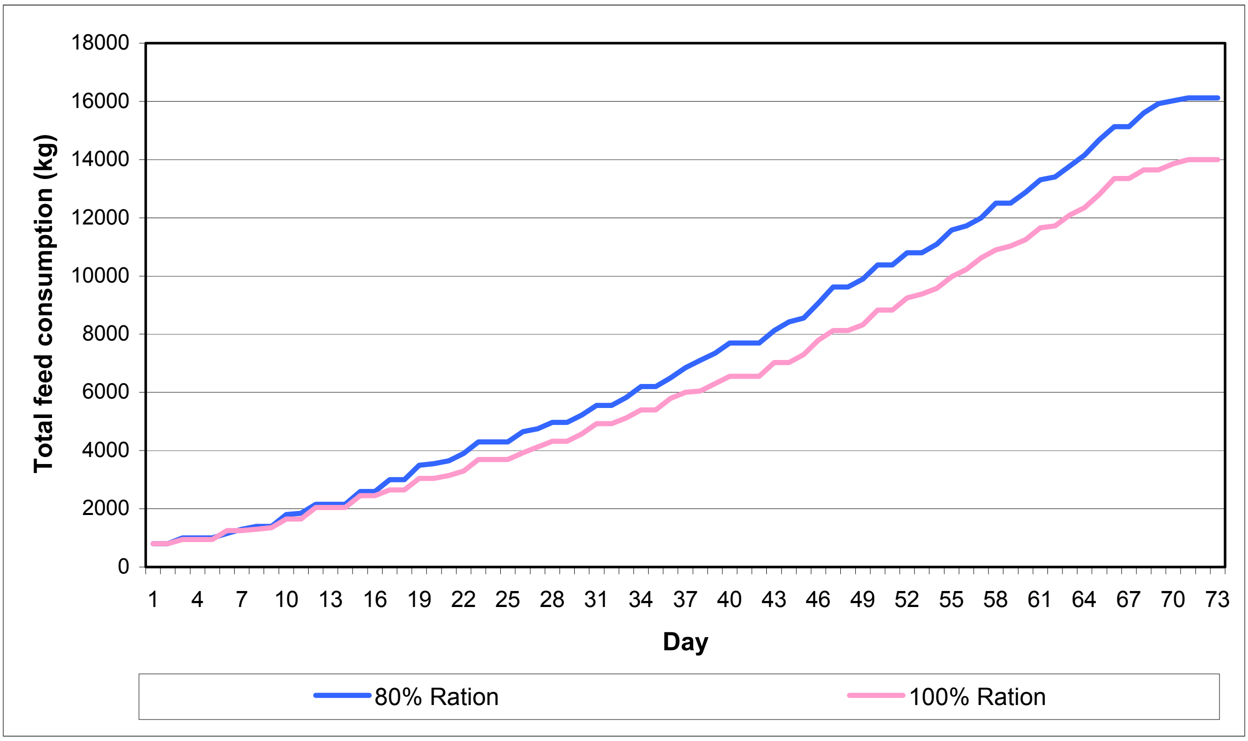

Figure 7: Comparisons of cumulative feed consumption (kg) for the trial birds on the 80 percent and 100 percent organic rations in the two sheds.

5.6. Feed Costing

5.6.1. Tables 4 demonstrate the estimated cost (£/kg) of the trial and the estimated cost that would have been incurred if the feed had have been brought in 'bulk' production amounts.

Estimated cost £/kg dressed carcase wgt			
		Trial Costing	Bulk Costing
Trial 1a	80% Ration	0.90	0.84
	100% Ration	0.87	0.81
Trial 1b	80% Ration	1.04	0.97
	100% Ration	1.03	0.96

Table 4: Estimated cost in £/Kg for the trial 80 percent and 100 percent organic rations. Expressed for both actual trial costing, and the costing if on a production bulk feed buy.

5.6.2. The table demonstrates a difference in feed cost. When considering all the birds and their dressed carcase weight, in terms of £/kg, birds on the one hundred percent ration were cheaper to feed. Thereby reducing production costs and enhancing production margins.

5.6.3. The final sale price is dependant on portioning, itself a function of sales costs and bird conformation (shape).

5.6.4. Although the one hundred percent ration is more expensive to purchase per kg, the difference is not reflected when considering the estimated marginal cost per kg of average dressed carcase weight (£/kg). This is possibly due to the fact that although the difference in average dressed carcase weight between the two ration types is small there is a large difference in feed consumption between the two ration types.

5.6.5. It must be taken into account that these calculations of cost are estimates, as they are based on the average weights for a small sample of birds, not average weights for all the birds. In addition, the above calculations are based on absolute numbers into the production system at the start of the trial, and do not take into account mortalities. In the first half of the trial mortalities were five percent higher for birds on the one hundred percent organic ration. However, in the second half of the trial there was only a one percent difference in mortalities, hence this is more representative of the difference in estimated marginal cost per kg of average dressed carcase weight (£/kg) between the two rations, and still indicates a cheaper cost for the one hundred percent ration. In future smaller scale trials obtaining weights for each bird should be possible, so it should in turn be possible to produce more accurate estimated costing.

Health Welfare and Behavioural Factors

5.7. Gait Scoring

5.7.1. For gait scores see figure 8.

5.7.2. There were no statistically significant differences in gait score, between the two ration types, genotypes or between different sheds.

5.7.3. Lameness, characterised by an abnormal gait and impaired walking ability, can be a major welfare concern in the flock (Butterworth *et al.* 2002). However, with the majority of trial birds having low gait scores one week prior to slaughter, this indicates low levels of lameness and good leg health and welfare.

5.7.4. The prevalence of leg problems in conventional broilers is normally very high (Sanotra *et al*., 2001) and compromise bird welfare. When compared with figures for large-scale studies of conventional Danish broilers (see figure 9) the lameness of the trial flock is low (Singh-Sanotra, 1999).

5.7.5. Gait scoring is good, although subjective it provides a practical method for assessing broiler lameness, without pathological investigation. However, lameness is complex and can have multiple causes which are intertwined and difficult to identify, for example infectious origin, skeletal abnormalities or the fact that broilers are fast growing and become too heavy for their legs, or distorted in shape so pose unnatural stresses on their joints (Bradshaw *et al.* 2002). Thus it is difficult to identify when lameness becomes painful and hence a welfare problem.

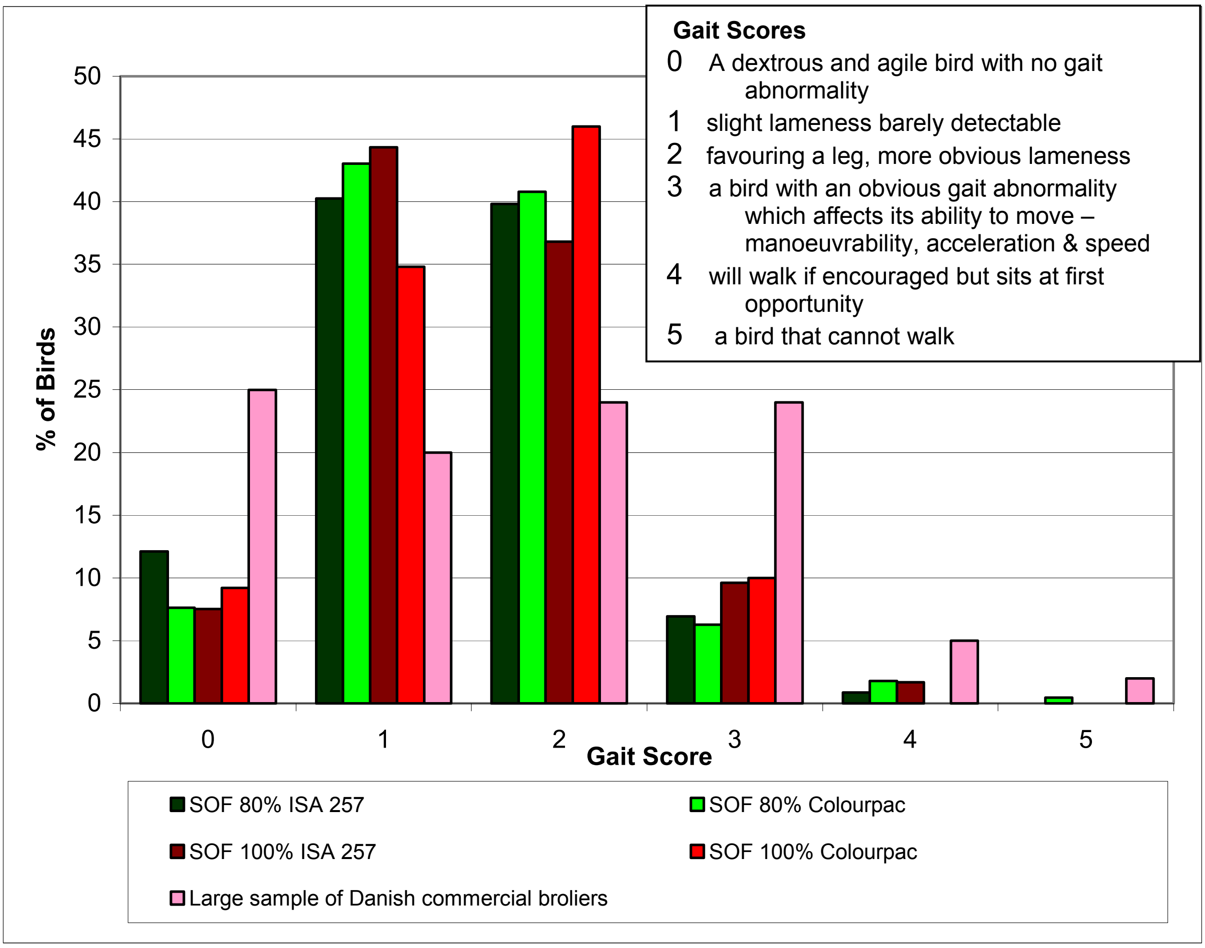

Figure 8: Gait scores for breed and feed trial regimes for Sheepdrove birds (SOF), one week prior to slaughter, compared with figures for Danish commercial broilers, (cited from Singh-Sanotra, 1999).

5.8. On-line flapping, bird cleanliness, feather damage and contact dermatitis

5.8.1. For scores of flapping, feather pecking, bird cleanliness and contact dermatitis see table 5.

Condition	ISA 257 80% ration	Colourpac 80% ration	ISA 257 100% ration	Colourpac 100% ration
Cleanliness 0-2 scale (*increasing dirtiness*)	0.81	0.66	0.90	0.63
Feather Pecking 0-2 scale (*increasing severity*)	0.50	0.41	0.61	0.39
Flapping 0-4 scale (*increasing severity*)	0.75	0.98	0.62	0.89
Foot pad dermatitis 1-5 scale (*increasing severity*)	3.04	3.11	2.90	3.04
Hock burn 1-5 scale (*increasing severity*)	1.38	1.31	1.30	1.31

Table 5. Effect of genotype and ration type on average scores for flapping, bird cleanliness, feather pecking, flapping and contact dermatitis.

5.8.2. On-line flapping

5.8.2.1. During the course of the trial it was noticed that ISA 257 birds had more wing damage in the form of red wing tips and wing haemorrhaging than Colourpac birds. It had been noted that Colourpac birds tended to flap and be more 'skittish' when being handled.

5.8.2.2. To investigate this, the trial was adapted during its lifetime to include the collection of on-line flapping scores to see if there was a true difference in flapping, between the two strains and how this might affect the wing damage that was found on the bird carcases.

5.8.2.3. A statistically significant difference was found in the levels of on-line flapping between the two genotypes (X^2=12.448, df=4, p=0.013) suggesting more severe flapping in Colourpac birds.

5.8.2.4. This does suggest, when combined with the data for wing damage, that this could be the result of a real difference in the general robustness of the two strains, with ISA 257, flapping less but being a less robust bird and more easily damaged. Alternatively, this could be the result of over vigorous plucking, with the action of the rubber fingers causing damage. It could also be the result of a difference in skin thickness between the two strains.

5.8.2.5. However, this trend in flapping scores is not very clear and only very slight. It is possible that this is due to the small size of the data set, as data on flapping was only collected in the second batch of birds, and the finding would be clearer in a larger data set.

5.8.3. Cleanliness

5.8.3.1. ISA 257 assessed as slightly dirtier, this was a statistically significant finding (X^2=16.268, df=2, p<0.001) but it was possible that this was due to the ease of evaluation of ISA 257 birds, due to their white colouration. Also the trend may not be clear due to the small data set. In future trials, this should be investigated the week before slaughter when weighing the birds, so they are not on-line and therefore in lighter conditions, to see if this is an artefact of colour rather than a true breed difference.

5.8.3.2. Cleanliness could be a potential health and welfare problem as dirtier birds are exposed to the possibility of infection. However severely dirty birds were only found in small numbers.

5.8.4. Feather damage

5.8.4.1. A statistically significant difference in levels of feather damage was found between the two genotypes (X^2=18.439, df=2, p<0.001). The finding suggests a trend of more acute feather pecking damage in ISA 257 birds. It is possible that this is due to the small size of the data set, as data on feather pecking was not collected on all processing days. This uncertain trend could also be due to the ease of evaluation in ISA 257 birds. Although there was a difference in the level of feather pecking between the two strains overall this behaviour was at very low levels.

5.8.5. Contact dermatitis: Foot pad dermatitis

5.8.5.1. The level of foot pad dermatitis was relatively high compared with conventional broilers (Ekstrand *et al,* 1997) for all the birds (see table 5), with no statistically significant differences between genotypes.

5.8.5.2. Contact dermatitis is a non-infectious condition (Krasnodebska-Depta, 2003) thought to be caused by a number of different factors including; inadequate housing conditions, litter type and state, humidity and density, feeding errors, biotin, methionine or excess soyabean meal (Krasnodebska-Depta and Koncicki, 2003), wet litter (Wang *et al.* 1998), thick/deep litter and high ammonia levels (Ekstrand *et al.* 1997).

5.8.5.3. Although non-infectious lesions may be a gateway for bacteria that reduce carcase quality, the severe lesions may be painful to the birds, which is a welfare issue (Ekstrand *et al,* 1997). It has been noted that it is difficult to identify if footpad dermatitis is painful for the birds it affects. It is suggested that the mild cases are not likely to affect the bird, but conversely it is very difficult to claim that severe cases are not painful. Due to the commonness of some form of gait abnormally (as discussed earlier) which could be due to weight or bird composition in addition to pain, it is very difficult to identify any lameness directly associated or caused by footpad dermatitis. (Ekstrand *et al.* 1997).

5.8.5.4. One reason for the high lesion scores and acuteness of the footpad dermatitis in these Sheepdrove birds could be the litter type used. Research has shown the use of long straw and the use of a deep litter system can exacerbate foot lesions (Ekstrand *et al.* 1997). In addition to this, the environment in conventional broiler sheds is very warm which helps to keep the litter dry. The substrate tends to be sawdust and which can be dryer than straw.

5.8.5.5. Some research has been carried out by EFRC at Sheepdrove to evaluate the use of long and chopped straw as litter types. This research was inconclusive as there were problems with the supply of the chopped litter type.

5.8.5.6. It is important to consider, that although the foot pad dermatitis was relativity high when compared with conventional systems, this comparison was made with a commercial broiler house, and not a free-range conventional system, with similar extensive conditions to Sheepdrove. If the data is available this should be compared with data from subsequent trials, to identify if this level of foot pad dermatitis is normal in this type of extensive system.

5.8.5.7. Continued monitoring of footpad dermatitis should be undertaken and if severity level continues or increases, management may need to be reviewed and further research should be considered into litter type.

5.8.6. Contact dermatitis: Hock burn

5.8.6.1. There were no significant differences in the levels of hock burn between the genotypes.

5.9. Behavioural Observations

5.9.1. Paired two sample t-tests were performed to compare the behaviour observed for the two genotypes and ration types. Tests were conducted for each behaviour, for every week (from weeks 6-10). Observations made both inside and out and were done for all four regimes.

5.9.2. Despite carrying out so many tests, very few differences in behaviour were found.

5.9.2.1. When comparing the different behaviours of the two genotypes, across the weeks in both locations there was only one significant difference. This was for ‘pecking objects’ (see appendix 3) in week seven, outside, (t=2.45, 6df, p=0.05). ISA 257 birds performed this behaviour significantly more than Colourpac under these conditions.

5.9.2.2. There was a significant difference between ration types when considering ‘pecking straw/grass’ (see appendix 3) in week ten, outside, (t=7.46, 3df, p=0.005). Birds on the one hundred percent ration performed this behaviour significantly more than birds on the eighty percent ration under these conditions.

5.9.2.3. There was a significant difference between ration types when considering ‘pecking loose feathers’ (see appendix 3) in week ten, outside, (t=12.17, 3df, p=0.001). Birds on the one hundred percent ration performed this behaviour under these conditions significantly more than birds on the eighty percent ration.

5.9.3. Although the above are significant findings the actual observed number of difference are very sporadic with very little pattern or trend to them. Of all the behaviours examined, there were some limitations on the number of occasions on when observations were made and of the type of behaviours studied.

5.9.4. Although significant the small number of differences found between ration types and genotypes in relation to the behaviour of the birds, do not suggest any firm effects of ration type and genotype on the behaviours observed. For example, the birds of difference genotypes and ration types were not consistently (over the 4 week observation period) feeding or foraging in the straw or grass in significant numbers. This finding suggests that overall a change to one hundred percent ration and / or a

Colourpac bird would not cause any change to the behaviour of the birds in the Sheepdrove system.

5.9.5. However, it is important to remember that the interaction of the two genotypes of bird may have modified the behaviour of the ISA 257 birds when compared with production sheds containing only ISA 257 birds.

5.9.6. In addition this type of behavioural sampling is very broad and can be insensitive to very small differences in behaviour. ‘Time budgeting’ using observations on individual birds over regular time periods should be considered for future trials.

6. Conclusions

6.1. The trial indicates a small statistical difference in the dressed carcase weights of the birds, with the birds on the one hundred percent ration having slightly lower average weights. However in practice, in terms of production, and in the context of the soon to be removed derogation, this difference is minimal at most. The average performance regardless of ration type or genotype is very similar.

6.2. The fears raised that moving to a wholly organic ration would increase the cost of production, through increased feed cost, have not been borne out by research to date.

6.3. There were no overall health or growth or welfare issues when comparing the two rations, contrary to suggestions that there might be due to the suggested nutritional inadequate in the one hundred percent organic ration.

6.4. The findings of the trial indicate that both strains, the ISA 257 and Colourpac bird, are suitable and conform to the requirements of the Sheepdrove system.

6.5. There were some slight differences found between the two strains, with ISA 257 birds prone to more problems (red wing tips, haemorrhaging, and back bruising dirtiness and feather damage) although these were at low levels overall. Despite this the ISA 257 had a slightly better carcase conformation.

6.6. The trial does highlight potential concerns for general bird / flock health and welfare. These are with regards to footpad dermatitis, which was universally acute in all the birds across the trial regimes. A result of the system, and not the genotype or ration type. However as discussed above this should be compared with more results for similar conventional and organic systems to determine if this high level is a problem for this type of extensive system in general. Some research has been carried out by EFRC at Sheepdrove to consider the use of long and chopped straw as litter types. This research was inconclusive as there were issues with the supply of the chopped litter type.

6.7. There were no overall behavioural implications of the different regimes on the birds.

6.8. These findings, coupled with the fact that in terms of production the one hundred percent birds were cheaper per kilogram to produce, suggest there is no economic impact in converting to a one hundred percent organic ration.

6.9. It is our conclusion that on the basis of this trial there would be no implications in moving to the one hundred percent organic ration when required to do so, with either strain, but may suggest the Colourpac for its increased carcase weight and tendency for better carcase quality in terms of red wing tips and cleanliness. However it is considered that further work is needed to confirm these findings.

6.10. It is important to consider that these findings are withstanding seasonal affects as this trial was conducted during the spring and summer period.

7. Further Work

7.1. To factor in the effect of season, in particular winter weather and temperatures, to investigate whether the current findings are robust under these conditions

7.2. Further investigation will be carried out into one hundred percent organic rations with differing compositions.

7.3. Continued monitoring of footpad dermatitis should be undertaken and, if severity level continues or increases, management may need to be reviewed. Further research should be considered into litter type, to extend the previous inconclusive work into alternative litters, and into comparisons with more extensive systems.

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Appendix 1

Feed Composition

Humphries 80% Organic Chick Crumb Starter

Ingredients

Organic wheat
In-coversion wheat
Organic peas
Fish meal (prohibited for ruminants)
Organic exp sunflower
Non GM full fat soya
Wheatfeed
Non GM prairie meal
Limestone
Monocalcium phosphate
Potato protein
Non GM soya & rape oil exp
HF Sup Roche Org BR 2959015
Salt
Sodium Bicarbonate
Betafin
Roxazyme G2G

Analysis	
Protein	20.55 %
Oil A	4.27 %
Fibre	4.48 %
Ash	6.61 %
Methionine	0.40 %

Vitamins and trace elements	
Vitamin A	12000ju/kg
Vitamin D3	2500 ju/kg
Vitamin E (alpha tocopherol)	60 mg/kg
Copper (part from copper sulp)	30 mg/kg

Humphries 80% Organic Finisher

Ingredients

Organic wheat
In-coversion wheat
Organic exp sunflower
Non GM full fat soya
Fish meal (prohibited for ruminants)
Organic peas
Wheatfeed
Non GM prairie meal
Limestone
Non GM soya & rape seed exp
Monocalcium Phosphate
HF Sup Roche Org BR 2959015
Yellow Pigmentation
Salt
Sodium Bicarbonate
Betafin
Roxazyme G2G

Analysis	
Protein	19.26 %
Oil A	5.39 %
Fibre	4.67 %
Ash	6.61 %
Methionine	0.37 %

Vitamins and trace elements	
Vitamin A	12000ju/kg
Vitamin D3	2500 ju/kg
Vitamin E (alpha tocopherol)	60 mg/kg
Copper (part from copper sulp)	30 mg/kg

Humphries 100% Organic Chick Starter Crumb

<u>Ingredients</u>

Organic wheat
Organic full fat soya
In-coversion wheat
Organic exp sunflower
Organic peas
Monocalcium phosphate
Limestone
HF Sup Roche Org BR 2959015
Salt
Sodium Bicarbonate
Roxazyme G2G
Betafin

<u>Analysis</u>

Protein	19.00	%
Oil A	6.16	%
Fibre	5.28	%
Ash	7.27	%
Methionine	0.30	%

<u>Vitamins and trace elements</u>

Vitamin A	12000	ju/kg
Vitamin D3	2500	ju/kg
Vitamin E (alpha tocopherol)	60	mg/kg
Copper (part from copper sulp)	30	mg/kg

Humphries 100% Organic Finisher

<u>Ingredients</u>

Organic wheat
Organic full fat soya
In-coversion wheat
Organic exp sunflower
Organic peas
Monocalcium phosphate
Limestone
HF Sup Roche Org BR 2959015
Salt
Sodium Bicarbonate
Roxazyme G2G
Betafin

<u>Analysis</u>

Protein	18.00	%
Oil A	5.47	%
Fibre	5.18	%
Ash	7.08	%
Methionine	0.28	%

<u>Vitamins and trace elements</u>

Vitamin A	12000	ju/kg
Vitamin D3	2500	ju/kg
Vitamin E (alpha tocopherol)	60	mg/kg
Copper (part from copper sulp)	30	mg/kg

Appendix 2

Protocols

A. Chick Arrival

- Time of arrival varies, from any time after 1pm, minimum of 2 people required
- Arrive as hatched (mixed sex), in genotype separated crates of 120-130 birds per crate
- Trial brood sheds assigned ration type, one of 100 per cent and one of 80 per cent
- Crates of each genotype divided equally between two allocated trial brood sheds
- Birds counted out of crates to obtain exact numbers of each genotype in each brood shed
- 50 birds of each genotype from each brood shed are weighed as they are counted out of the crates
- Birds are weighed using Welltech 'chick weigher'

B. Weekly Weighing in Brood Sheds

- To be carried out weekly, will require a minimum of 2 people
- Using MDF boards (part of the existing brood shed furniture) construct a temporary holding pen, leaving an opening in order for the chicks to enter
- In order to herd the birds into the holding pen identify a large group of individuals. Approach from the rear of the group walk slowly behind the chicks, herding them into the pen taking care to minimise stress
- Suffocation is a risk, therefore assess numbers and release some individuals if necessary
- Fifty birds of each genotype from each brood shed are weighed, with details recorded on Breed and feed data sheet 1 (B&F sheet 1)
- Birds are weighed using Welltech 'chick weigher' and are replaced back into the main brood shed area and not the holding pen

C. Transfer of birds from Brood Sheds to Field Sheds

- To be carried out in week three and will require a minimum of 4 people in total
- All brood shed furniture to be removed by the poultry team
- Ensure there are no birds in the conservatory, then close pop-hole
- Using MDF boards, herd all chickens into approximately one third of brood shed area. There needs to be enough floor space available in the pen to place three module trays and ensure the birds do not suffocate
- Member of the poultry team to transfer two modules into the brood shed, one module will be unloaded into one end of each field shed
- Loading the modules must be completed in semi-darkness, in order to keep the birds calm, therefore close all skylights and turn off lights. Leave just enough light to be able to determine genotype
- Once the birds have settled place 3 module drawers in the pen, one person to load each drawer. Place an empty module drawer on top of the one being loaded in order to prevent birds jumping out
- Drawers must be genotype specific with a maximum of fifty birds in each
- Fourth person to co-ordinate, their role includes:
    i. Ensuring fifty per cent of the birds from each genotype are allocated to each module and the module drawers are labelled according to ration type for that brood shed

ii. Keeping note of total number of each genotype in each module
iii. Organise loading of drawers into modules (top-down, column-wise for bird safety)

- Repeat process for second brood shed
- Member of the poultry team to load modules onto trailer and transport to field sheds
- One module from each brood shed to be unloaded into the allocated end of each field shed for the relevant ration type, according to pre agreed field shed layout
- Unload module drawers (bottom-up, column-wise)

D. Weighing in Field Sheds

- To be carried out weekly, in the final week (week 10) sheds to be weighed the day before depletion. A minimum of 2 people required.
- Close the pop holes on one side of the shed
- Using MDF boards (existing shed furniture) construct a temporary holding pen, leaving an opening in order for the birds to enter
- In order to herd birds into holding pen, identify a large group of individuals. Approach from the rear of the group, walk slowly behind the chickens herding them clockwise passed the closed pop-hole into the pen, taking care to minimise stress
- Suffocation is a risk, therefore assess numbers and release some individuals if necessary
- Fifty birds of each genotype from each end of the field sheds are weighed (a total of 400 birds), with details recorded on B&F sheet 2
- Birds are weighed using Welltech 'adult bird-weigher', suspended from a structural beam with a large bucket attached, and are placed back into the main field shed area, not the holding pen

E. Behavioural Observations

- To be carried out weekly commencing week six, only 1 person required
- Observations to be made for each ration type in each shed both inside and out (8 sets of observations), recording details on B&F sheet 3
- A set of observations include a scan sample for each genotype of the following behaviours:- feeding (inside only), pecking straw/grass, pecking objects, pecking lose feathers, feather peck (bird), bird peck (flesh) and dust bathing.
- Approach sheds quietly so as not to disturb the birds
- Prior to starting each set of observations, the birds are given five minutes habituation time in which to adjust to the observer's presence
- Before each set of observations the total number of birds of each genotype visible are recorded (a bird is visible if the observer can see its head)
- Each behaviour is assessed for 30 seconds per genotype. The number of birds of the relevant genotype performing the behaviour being observed in that 30 second time frame are recorded on B&F sheet 3
- Fighting is a two way interaction and so may occur between birds of different genotypes, therefore within a set of observations it is recorded once over a 1 minute time period and all birds (i.e. both ISA 257s and Colourpacs) involved in fights are recorded
- For outside observations, total bird counts are made between each behavioural scan sample

- For inside observations, three total bird counts are performed during a set of observations. Additional counts may be needed if there is a noticeable large movement of birds during the observations

F. Gait Scoring

- To be carried out in week nine, prior to depletion, a minimum of 2 people required. At least one person needs to have completed a half an hour training session with Andy Butterworth, University of Bristol
- Enter the shed quietly, taking care not to scare birds
- Using MDF boards (existing shed furniture), construct a temporary holding pen around a large group of individuals. DO NOT herd birds into the pen, as with weighing, so as not to select for birds that can walk well
- Encourage birds to walk out of the holding pen, one at a time, and score their gait, using the gait scoring system supplied by Andy Butterworth, University of Bristol during the training session
- Aim to collect scores for fifty birds of each genotype for both ends of each shed, details to be recorded on B&F sheet 4

G. Slaughter - Catching

- To be carried out in week 10, one shed on the Monday (Day 71) and the other on the Wednesday (Day 73), approximately 1000 birds to go to processing each day.
- Catching starts at 4am and will require 3 members of the research team in addition to the 5 members of the regular catching team
- Catching must be completed in darkness in order to keep the birds calm, therefore all the sheds doors and windows must be closed before catching begins
- Member of the poultry team to place one module in front of field shed just outside the door
- Fifty-one birds of each genotype from each ration type (end of the shed) are required for examination during processing
- Four members of the poultry catching team identify and catch 51 birds of one genotype from the door end of the shed
- Birds are caught by both legs, their breast being held against the catchers leg to calm it, two birds are caught in each hand
- Caught birds are passed to two researchers by the shed door who check the genotype and place the birds in a module drawer
- Module drawers must be genotype specific with seventeen birds in each. One person must stand either side of the drawers to count the birds in and to ensure they don't jump out of the trays
- Module drawers are filled top-down row wise, for bird safety, with one genotype to a row (51 birds in each row).
- A researcher checks bird numbers and colour-codes the drawers using ribbon
- The second genotype of bird from the door end is caught and loaded into the second row of module drawers using the same procedure
- The two genotypes for the far end of the shed are caught using the same procedure but are handed over the divide to the two researchers who transfer them to the module, where they are loaded into the third and fourth row of drawers in the module, again loaded by genotype
- Member of the poultry team to load modules on to trailer
- Remaining birds caught as per normal for the production birds and loaded into modules by all personnel

- Procedure repeated on the Wednesday for the second trial shed remembering that the two ration types will be in the opposite ends to the first shed
- Member of the poultry team transport the birds to lairage at the processing plant to await the next stage

H. Slaughter – Processing

- Processing starts at 8am on the same days as catching, see Protocol G, a total of four people will be required.
- Member of hanging-on team to transfer trial bird module from lairage to the hanging-on room
- The hanging-on room is lit only by blue light in order to keep the birds calm, as birds can not see blue light
- A member of the research team to be in the hanging-on room to ensure the trial module is unloaded first and appropriate gaps are left between each genotype and ration type
- Members of the hanging-on team to unload the module bottom-up row-wise, so birds are placed on the line in ration/genotype groups
- Between groups there is a 10 shackle gap, so the groups of 51 birds can be easily identified by staff and researchers
- Post hanging-on but pre-plucking, the birds are scored for feather pecking/cleanliness/flapping using scoring systems supplied by Lindsay Wilkins, University of Bristol (1 person required)
- Post plucking the birds are scored for foot and hock burn using scoring systems supplied by Steve Brown, University of Bristol (2 people required)
- The birds then enter the chiller which takes approximately 1 and a half hours for the birds to pass through
- Post chilling the carcases are placed in baskets by members of the processing team as they come off the production line therefore they are kept in their genotype/ration groups. They are now scored for breast blisters, skin blemishes, breast bruising, leg bruising, red wing tips, and wing haemorrhage, using scoring systems supplied by Lindsay Wilkins, University of Bristol.
- Carcase weight are obtained and recorded by members of the EFRC research team on B&F sheet 5.

Appendix 3

Ethogram of Behaviours recorded in Observations

Behaviour	Photograph	Description
Feeding		Birds pecking at / ingesting feed within feeder (INSIDE ONLY)
Pecking straw		Birds pecking at straw
Pecking grass		Birds pecking at grass
Pecking objects		Birds pecking at any other surface or object (excluding drinker, birds, straw / grass or feed within feeder). Including, house, perches, feet dip bucket
Peck loose feathers		Bird pecking at loose feathers, no longer attached to itself or other birds

Feather-peck bird		Bird pecking at feather on another bird
Bird-peck (flesh)		Bird pecking at flesh (legs, comb, wattle) on another bird
Fighting		Bird fighting with another bird. Includes squaring up, head lowering, and ruffle of neck feather. Can include squawking, pacing and jumping at, or aggressively pecking, the other bird. Includes the antagonist and defender, as long as both engage in head lowering and squaring up, if not just antagonist is classed as fighting
Dustbathing		Dustbathing includes the following elements, scratching, whilst laying down or squatting down, ruffling back, wing and leg feathers.

Appendix 4

Cleanliness	0	Clean
	1	Small area of dirt
	2	Large area of dirt
Feather Pecking	0	No Evidence
	1	Small amount of pecking
	2	Serve pecking
Flapping	0	No flapping
	1	Slow flapping short burst
	2	Rapid flapping short burst
	3	Rapid flapping long duration
	4	Rapid flapping long duration extreme form with bird curling up
Foot pad dermatitis	1	No lesion
	2	Very small superficial lesions: slight decolouration limited area
	3	Mild lesion: discolouration footpad, superficial lesion/dermatitis
	4	Moderate severe: ulcers or scabs
	5	Very severe: ulcers or scabs, signs of haemo or deep dermatitis
Hock Burn	1	No Lesion
	2	Very small superficial lesions: slight decolouration limited area
	3	Mild lesion: discolouration footpad, superficial lesion/dermatitis
	4	Moderate severe: ulcers or scabs
	6	Very severe: ulcers or scabs signs of haemorrhage/deep dermatitis
Breast Blister	0	No lesion
	1	Small to mild lesion
	2	Moderate severe to severe lesion
Skin Blemish	0	No lesion
	1	Small to mild lesion: small patch red or mark
	2	Moderate severe to severe lesion: deeper large red marks
Back Bruising	0	Very minor or no bruising
	1	Small area of bruising some light red colouration
	2	Large area of bruising: deeper red colouration
Breast Bruising	0	Very minor or no bruising
	1	Small area of bruising some light red colouration
	2	Large area of bruising: deeper red colouration
Leg Bruising	0	Very minor or no bruising
	1	Small area of bruising some light red colouration
	2	Large area of bruising: deeper red colouration

Red wing tips	0	No evidence or very minor
	1	Small area of red on tips of wing
	2	Large area of red on wing tips with deeper colouration
Wing Haemorrhage	0	No evidence or very minor
	1	Small area of haemorrhage
	2	Large area of haemorrhage
Conformation	0, 1, 2, 3	

Judged by eye on overall shape and size of carcase, paying particular attention to the shape and proportions of the breast.