Absence of carcass defects after commercial extremes in dietary CP and ME minimizes broiler formulation as a welfare concern

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Defects associated with broiler carcasses were used to reveal adverse welfare when dietary CP and ME varied. Chicks were reared sexes-separate in floor pens from 0 to 42 days of age on common feeds. During the subsequent 42-56 days, feeds having CP at either 18.0 or 16.5% while ME was either 3250 or 3090 kcal / kg were given. All feeds either attained or exceeded minimum nutrient requirements. At 56 days, feed was withheld 12 hours, and birds processed using automated equipment. Warm carcasses were static chilled in slush-ice for 4 hours then one person evaluated the incidence of: wings having dislocated joints, bruising, broken bones, and brachial veins expressing extra-vascular blood; drumsticks with broken bones and bruising; breast bruising and broken clavicles; and back-thigh area having bruising, torn skin and scratching. Wing bruising was the defect having the greatest incidence (19.0%) and breast bruising the least (0.4%). Males exhibited a greater vascular disruption of blood in the wing veins, broken drumsticks and back bruising than females while the converse occurred for drumstick bruising and skin tearing of back-thigh area (P<.05). No significant effects were detected that could be attributable to level of CP and/or ME (P>.05). Absence of carcass defects associated with wide variations in feed CP and ME levels infer a minimal threat to broiler welfare that could be attributed to normal variations of these nutrients.

Keywords: feed formulation, meat quality, metabolizable energy, protein nutrition, welfare

Introduction

Commercial formulation of feed usually results in marginal levels of energy, protein, and phosphorus because of their associated costs. Phosphorus is of most concern for the bird because of adverse physical conditions when in low amounts, however, little is known relative to energy and protein (Whitehead, 2002). Generally, CP can decrease markedly when purified essential amino acids are employed while ME can vary independently, particularly with accessibility and source of fat. Injuries sustained until slaughter are a physical index that indirectly relates the bird’s preceding terms of care; in turn, such auditing is being implemented to document adverse conditions with broilers commercially produced (Marion, 2004). Defects associated with the carcass are predominantly bruising and broken bones which are used to assess its yield and quality (Thomason, 1977; Anonymous, 1986; Bilgili, 1997); however their itemization also enables an indirect index of the bird’s welfare. Experimentation was conducted using extremes in feed CP and ME with broilers prior to marketing. Defects
associated with their carcasses were itemized to estimate if formulation differences restricted to these nutrients would be of welfare concern.

Materials and methods

Ross X Ross 308 chicks obtained from a commercial hatchery were reared sexes-separate in floor pens having fresh pine shaving litter (4.18 m²). Pens were located in an open-sided house having thermostatically controlled heating, window curtains, and cross-ventilation. Vaccinations for Marek’s Disease, Newcastle Disease, and infectious bronchitis were done at the hatchery while immunization for infectious bursal disease was done at 10 days of age. Experimentation was conducted from early through to late spring. Temperature and humidity probes within the house continuously provided measurements throughout experimentation. Common corn-soybean meal feeds corresponding to nutritionally adequate terms employed by the industry-at-large (NRC, 1994; Agri Stats, 1999) were provided from 0 to 42 days of age. From 42 through to 56 days of age, birds received feeds representing a factorial arrangement of two levels of CP and two of ME for a total of four treatments each represented by four replicate pens having 17 broilers. The high CP (18.0%) and high ME (3.25 kcal ME/g) corresponded to the upper limit of practicality, whereas the low CP (16.5%) and low ME (3.09 kcal ME/g) approximated a lower limit. All essential amino acids (EAA) and other nutrients attained or exceeded accepted requirement levels (NRC, 1994; Agristats, 1999) for each of the fours feeds. Corn, soybean meal, poultry fat, and purified limiting essential amino acids were the only feedstuffs employed to alter CP and ME. All feeds were steam-pelleted and presented from 0 to 3 weeks as a crumb and whole pellet thereafter. Lighting was continuous but of maximal intensity with daylight and minimal at night from incandescent illumination. Feed and water were provided ad libitum.

At 56 days of age, feed access was withdrawn but water continued for 12 hours until cooping and slaughter. “On-line” processing involved a 9 minute kill line followed by a 7 minute evisceration line until chilling. Stunning (10 seconds, 20 mA) was immediately followed by manual severance of carotids and jugular veins to assure rapid death from exsanguination. Subsequent warm carcasses without neck and all viscera were static chilled in slush-ice for four hours. One person and the same person evaluated each carcass for the incidence of individual defects, respective of type and location (wings- dislocation of joints, broken bones, bruising, and extra-vascular loss of blood from the brachial veins; drumsticks- broken bones and bruising; breast- bruising and breakage of clavicle; back and thigh- bruising, tearing of the skin, and skin scratching). Each defect was expressed as the percentage occurrence within the population originating from each pen. Carcasses were identified by their wing band and the processing of birds as well as assessment for defects was completely random. Percentage data were transformed to the arcsine of the square root for statistical analyses. A valid standard error of the mean values could not be obtained using transformed values with analysis of variance (ANOVA); however, an estimate of the SEM and variance for each defect is given from ANOVA using actual percentages. ANOVA was conducted as a factorial arrangement of CP and ME using a randomized complete block design. Blocks corresponded to pen rows during live experimentation. Computations employed the General Linear Models Procedure (SAS, 2001).

Results and discussion

Formulations to reduce CP from 18.0 to 16.5% led to reductions in soybean meal approximating 6% with corresponding increases in corn. Actual analyses revealed that high CP was about 17.5% and low 15.8%, with all EAA well above the levels considered adequate. Formulations that decreased the ME from 3.25 to 3.09 kcal/g essentially involved the removal of 3-4% added fat. Use of dicalcium phosphate, limestone, salt, and micronutrient mix changed little among the treatments. Average weights of males (2489 g) and females (2289 g)
at 42 days of age was similar among the intended feed treatments at the start of experimentation. During the subsequent 42 to 56 days of age, the average temperature (25±4 C) and relative humidity (80±12%) was high but enabled good liver performance. The influences of CP, ME, and sex on live performance were independent of each other, and no significant interactions could be detected (P>.05). Reducing CP decreased total body weight gain (995 vs 878 g, P<.001) while feed conversion increased (2.56 vs 2.84, P<.001) in manner that was similar with each sex. Reducing ME from did not influence body weight gain even though feed conversion increased (2.65 vs 2.75, P<.05). Differences in the amounts of chilled carcass paralleled that when alive, but depot fat removed from the abdominal cavity was unaffected by any feed while females had more than males (3.47 vs 2.73 %, P<.001).

Pen environment, particularly stocking density, has been of primary concern to broiler welfare during live production while scratching impairs carcass quality (Frankenhuis et al., 1991; Bessi, 2001). However, interim handling with marketing is usually associated with the greatest proportion of defects, particularly bruising (Ekstrand, 1998). The overall occurrence of defects generally increases with flock age and live weight (Bilgili and Horton, 1995). Present experimentation maximized detecting the influence feed formulation by equalizing the influences of pen environment, handling, and processing while accentuating defect frequency by using heavy broilers. Having one person evaluate each carcass with a complete randomization in their presentation also reduced background variance to improve detection. Bruising and skin scratching only occur when the bird is alive and their occurrence is assumed to provided a direct index of the bird’s relative welfare, whereas broken bones and skin tears may have also been created by carcass traumas during automated processing. Incidence of bruising to the wings and drumsticks was the most extensive carcass defect observed (Table 1), and the proportions agree with observations with other studies (Bilgili and Horton, 1995; Knierim and Gocke, 2003). The standard error of the mean given for each defect was derived using actual percentages and provided as an estimate of variance. Altering the dietary level of either CP or ME did lead to significant differences in the incidence of bruising on any part of the carcass nor any other defect (P>.05). However, males had more bruising of the back, loss of vascular integrity with the wing’s brachial vein, and broken drumsticks than females, whereas females suffered more bruised drumsticks and back skin tearing than males (P<.05). The males were reared and handled separate from females but processed together; thus, differences for these traumas could not be attributed to behavioural conflicts. Grade “A” relates proportion of carcasses without obvious defects, and neither sex, CP nor ME under terms of present experimentation had any influence.

Conclusion

Least-costing in the formulation of broiler feeds is most likely to alter CP and ME other nutrients other than phosphorus. Feeds formulated with corn, soybean meal, poultry fat, and purified amino acids provided CP and ME having factorially arranged differences approaching the limit of practicality. These feeds were given to broilers from 42 to 56 days of age when carcass defects would be readily expressed. Alterations in dietary CP and ME did lead to deviations in frequency of any defect by itself nor collectively as grade “A”. Given that defects such as bruising to be an objective index of animal welfare, then common variations in CP and ME that occur with feed formulation are unlikely to be of concern for the broiler’s welfare.
References


Table 1 Carcass defects of broiler makes and females at 8 weeks of age receiving feed with different levels of metabolizable energy and crude protein having an optimal amino acid balance between 42 and 56 days of age.

<table>
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<th>Contrasts</th>
<th>Wings(^2)</th>
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<th>Breast(^4)</th>
<th>Back-Thigh(^5)</th>
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1Values represent the average of 4 replicate pens each providing ca. 15 carcasses. Data were transformed into arcsine square root percentage for ANOVA, whereas the SEM’s were estimated from actual values. All interactions, P>.05.

2Wing defects correspond to: dislocated joints, broken bones, and brachial vein engorged with blood, respectively.

3Drumstick defects correspond to: broken bones and bruising.

4Breast defects correspond to: bruising and broken clavicle, respectively.

5Thigh-back defects correspond to: bruising, skin tears and skin scratches, respectively.

NS, P>0.05; *, P ≤ 0.05.