Agrosearch
Vol. 1, No. 2, December 1995 pp 163-169

A REVIEW OF THE EFFECT OF SEXUAL DIMORPHISM ON SOME CHARACTERISTICS OF THE DOMESTIC FOWL (*Gallus domesticus*)

E.A.O. LASEHINDE[1] and J.A. OLUYEMI
Department of Animal Production and Health,
Federal University of Technology, Akure.

ABSTRACT

Male and female domestic fowls differ in some anatomical and physiological features. For economic purposes, the feed consumption and consequent growth performance are of primary importance. The comparative feed consumption between male and female chickens and the influences of dietary energy and protein on each of the sexes are reviewed. There is also a focus on the comparative growth of the sexes in terms of body weight, muscular and structural growth. Effect of rearing the sexes separately or mixed is also highlighted.

INTRODUCTION

Sexual dimorphism is the manifestation of differences between male and female animal species. According to Fisher (1930), sexual dimorphism has many features, including gross structural differences between male and female, finer anatomical differences in brain anatomy, kidney structure, hepatic enzyme system, behavior pattern and the like. The potential for growth also differs between male and female birds (Mandlekar and Desmukh, 1983; Tapia, 1984; Keshri *et al.*,1985). Growth potential and consequent performance is very crucial to poultry meat production. This is primarily affected by nutrition among other things. As potential for growth differs between the sexes, it can be assumed that feed and feeding requirement will similarly vary. Based on this premise, some broiler farmers raise their birds as separate sexes. The objective of this review paper is to highlight the comparative feed consumption and growth performance of male and female chickens.

MANIFESTATIONS OF SEXUAL DIMORPHISM

1.Feed Intake and Utilization

The sex of an animal is an important determinant of growth rate, feed efficiency and carcass composition (Riche and Quire, 1986). Marks (1985) reported that male broilers consumed more feed and water than females immediately following hatch, and this increased with age. Farrell *et al.* (1973) reported that food intake was inversely related to energy concentration but metabolizable energy required by each sex to reach a given live weight was quite similar. Marks (1986 and 1987) also observed that when male and female broilers were restricted to equal amounts of feed and water intake for ten days, both sexes were identical in body weight, water and feed intakes. Following exposure to *ad lib* water intake thereafter, males immediately consumed 7-11% more water than females. Similarly, when provided feed *ad lib* thereafter, males consumed 8-9% more feed than females.

Marks (1987) submitted that feed and water intake patterns of male and female broilers were controlled by inherent mechanism independent of difference in body weight or maintenance requirements. In a review on the genetic and physiological effects of selection in meat type poultry, McCarthy and Siegel (1983) suggested that increased growth rate of selected broiler strains was mainly associated with increased appetite. Relating this suggestion to the studies of Marks (1985, 1986 and 1987), the male broilers would appear to have more appetite than the females.

In determining the effects of feed and water withdrawal on broiler yield parameters, Benibo

[1]All Correspondence to this author

and Farr (1985) discovered that liveweight shrinkage increased with increasing length of withdrawal and male broilers lost more body weight than the females. When subjected to different feeder and drinker spaces, there was no significant difference in the response of male and female broilers to the treatment in terms of growth rate (Siegel *et al.*, 1961).

Male broilers utilize feed more efficiently than the females (Sonaiya and Benyi, 1983; Musharaf and Latshaw, 1984; and Mendes and Cury, 1986). Reece *et al.* (1984) reported that feed conversion for males was 3.3% better than it was for females. In a trial conducted on broilers from 30-35 days of age of the birds, Wallis and Balnave (1984) reported that sex had no major effect on the ability of the birds to metabolize energy or digest amino acids. At high environmental temperatures however, male broilers digested amino acids better than the females. Contrary to the report of Wallis and Balnave (1984), Mendonca (1983) reported that female broilers utilized dietary energy more efficiently than the males between weeks 5 and 8 of their growing period. Similarly, Jones *et al.* (1980) reported that though there were no sex differences in absolute and relative weight gains, gain to feed ratio was significantly greater in females than in males.

Terrago and Puchal (1977) reported that high stocking rate adversely affected body weight and feed conversion efficiency of females more than males.

2. Energy Intake and Fat Deposition

Factors which influence fat deposition according to Arafa *et al.* (1983) include strain, breed, sex and age of bird, diet and environmental factors, including season of the year and temperature. Further to this, McMeekan (1940) stated that the percentage lipid in the depots was greatly influenced by the stage of development and plane of nutrition, with animals on low plane of nutrition having more water and less fat than animals on higher plane of nutrition.

When provided diets of varying energy levels, female broilers seemed to increase faster in weight to diets containing increased energy (Summers and Leeson, 1984). On the other hand, Fraga and Valdivis (1985) reported that males gained more body weight than females as a result of fat supplementation in the diet. Within the age range of 36-54 days, the abdominal fat as percentage of body weight increased with age and with increase in dietary energy level - 3100 to 3325 Kcal/Kg (Deaton and Loth, 1985). During this period, body weight of broiler increased by 75% for males and 72% for females. The abdominal fat expressed as percentage of body weight also increased by 23% for males and 38% for females.

Adult female birds contain more fat in their carcasses than males (Summer *et al.*, 1965; Godwin *et al.*, 1969). At older ages, or at higher body weights, the increase of fat content in the female exceeded by far, that in the males (Leenstra, 1986). Sonaiya (1985) reported that rate and extent of fat deposition decreased with age in male broilers. Evaluating the carcass yield of five strains of broilers at 8 and 9 weeks, Pandey *et al.*(1985) reported that males had lower fat and higher protein content than females. Sonaiya *et al.* (1986) indicated that the total body fat of female broiler was consistently higher than for males from ages 6 to 16 weeks. At a constant calorie:protein ratio, increase in dietary energy increased the body fat content of male chicken while that of the female was unaffected (Robbins, 1981).

On separating the abdominal leaf fat (ALF) into fat pad, fat around gizzard, viscera and heart, Heath *et al.* (1980) recorded higher fat pad value for male but higher value of fat around gizzard, viscera and heart for female. Dietary energy increase resulted in more ALF in the female slaughtered at 7 week than male. Changes in total ALF did not affect the relative percentage of the four separations.

3. Body weight

Sexual dimorphism in body weight is manifested through the different stages of development in the domestic fowl. Beginning from the embryonic stage, Burke and Sharp (1989) reported that the mean wet body weight of male embryo was significantly greater than that of the female at 11, 13 and 18 days of incubation, whether expressed on an absolute basis or as a percentage of egg weight. Male chicks hatched from egg heavier than 60g significantly weighed more than female chicks from eggs of similar weight (Khan *et al.*, 1975). They concluded that male embryos were able utilize the energy supplied in the egg better, particularly after the 18th day of incubation than the female embryos.

Whiting and Pesti (1983) reported that male broiler were heavier than the females at hatching. Verma *et al.* (1983) gave the average body weight at hatching as 40.31g for male chicken and 39.06g for the female. Sharma *et al*; (1983) reported that body weight at hatching was significantly affected by sex and strain of chicken. At hatching time, male were 1% heavier than females (North,1978). Male chickens have been reported to grow faster with heavier body weights than females under various rearing conditions (Mandlekar and Desmukh, 1983; Sonaiya and Benyi, 1983; Thangaraju *et al.*, 1983; Polanco and Vigil, 1984; Tapia, 1984; Fraga and Valdivis, 1985 and Keshri *et al.*,1985).

Marks (1985) reported that the difference between the sexes in body weight became significant after four days of age, though the difference in body weight started immediately post hatch and increased in a more or less linear fashion with age. At 14 days of age, he observed that males were 7% heavier than females. Sorensen (1977) reported that male broilers were more affected in body weight than the female broilers due to low protein in the diet. According to him, compared with normal diet, the low protein diet caused a decrease in growth rate which at 38 days was 37% for male and 25% for female.

4. Muscular growth

According to Duston and Carter (1985), the total amount of muscle that is present on any skeletal framework depends on the factors that control the growth and development of the muscle. In a study on the relation of body size to muscle size and number, Smith (1960) estimated the number of muscle cells at hatching and determined the cell size at 10 weeks of age by cross-diameter measurement of teased fibres from *Musculus sartorius*. He found that the muscle cell number was similar in the male and female birds. The males however had larger cell than the females which was responsible for the larger muscle size in the male.

The skin of chickens has also been studied. Kafri *et al.*, (1985) reported that regardless of diet, male broilers had stronger skin than females. Weinberg *et al.* (1986) also stated that the average tensile strength of male skin was higher than that of the female (1078g Vs 842g). Female skin, they reported, contained averagely more fat than male's (36.0% Vs 32.2%). Kafri *et al.* (1986) in another study reported that males had stronger though thinner skin than the females, with the difference in thickness being primarily due to difference in the adipose tissue rich hypodermis.

5. Structural growth

The studies of Yamani *et al.* (1982) revealed that male broilers had significantly higher values than females for measurements of body length, body circumference, thigh circumference, shank length, carcass weight and dressing percentage. Mandlekar and Desmukh (1983) and Keshir *et al.* (1985) reported only slightly higher values of males over females regarding dressing percentage. Najib *et al.* (1985) submitted that back, neck, breast and wing percentages in the carcass did not differ significantly with age at slaughter between 7 - 9 weeks.

Mahapatra *et al.* (1984) reported that male broilers had significantly higher values than females for liveweight at slaughter, eviscerated carcass weight, carcass yield and weight of drumstick, thigh and giblet. The female however had a significantly higher percentage of breast and neck than males. Sonaiya *et al.* (1990) reported that males has lower proportion of leg, leg - bone, and total meat to fat ratio than females. In a study on the effects of dietary energy levels and sex on broiler performance and carcass traits, Mendes and Cury (1986) reported that the percentage of leg, thigh, back, neck, head and shanks in relation to liveweight were higher in males though females had higher breast and abdominal fat values. Breast, back, gizzard and liver were heavier in female broilers than males (Merkley *et al.*, 1980 and Broadbent *et al.*, 1981) but males had higher values for leg, wing, neck and heart (Broadbent *et al.*, 1981).

Khanna and Panda (1983) recorded no significant difference between the sexes in the percentage yield of neck, wings and legs of the chicken; however, males were significantly higher in back plus ribs but lower in breast. Van (1984) had singularly difference observation concerning breast yield of the sexes. He reported that at 7 weeks of age, in a line of Cornish fowl breast weight of male was heavier than that of female.

Milicevic *et al*, (1986) reported that at three months of age, there was no significant difference in the bursal weight and structure between male and female chickens. At six months however, an advanced stage of bursal involution was observed in the male while only the initial signs of bursal involution were noticed in the female. Mean bursal weight between sexes was not significantly different (Glick, 1960). Prieto *et al*, (1985) reported that urinary hydroxyproline excretion tended to decrease with age in males and increase in females. Since most of the hydroxyproline is presumably derived from bone collagen, the result suggested that there were differences between male and female in mineral exchange processes.

EFFECT OF SEX SEPARATION ON SEXUAL DIMORPHISM

Gehle *et al*, (1974) cited by Sullivan *et al*, (1974) reported that there was very little apparent benefit from rearing the sexes separately. Lang *et al*, (1960) found no significant difference in body weight gain between the mixed and separated sexes. Kettlewell (1986) however reported that raising bird as separate sexes allowed the bigger male birds to develop at a slower rate than the females, particularly in the mid-growth period when a slower growth rate could result in lower mortality fewer leg disorders and improved profit margins. He also suggested that if broilers were to be separated into weight groups while raising them, 10 - 25 days of age was a good age range for doing so. Mejierhof (1988) observed that birds separated into sexes had significantly lower feed intake than those managed as mixed - sexes.

CONCLUSION

Male broilers consume more feed and utilise the same more efficiently than the female. At finishing phase, usually between 5-8 weeks, female broilers utilise high energy diets better than the male for fat deposition and consequent body weight. Adult female chicken generally have more carcass fat and less protein than males. It is suggested that feed and water intake patterns of the male and female chickens are controlled by inherent mechanism which are sex - characterized rather than body weight or maintenance requirements. Feed and water deprivation affects the males more than the females. Similarly, males are more affected by low protein intake than the females.

Sexual dimorphism is manifested through the various phases of the chicken's development, beginning from the embryo. The male embryos as well as the newly hatched chicks are averagely heavier than their female counterparts. The adult male chicken has large muscle and stronger but thinner skin than the female though the female has more fat in the skin. Males have higher values than females for body length, body circumference, thigh circumference and shank length. They are also superior in eviscerated weight, carcass weight, dressing percentage, as well as weight of drumstick, thigh and giblet but the female is superior to the male in the weight of neck and breast. Raising the sexes separately or mixed tends to have no significant effect on body weight gain.

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