*Pak. J. Agri. Sci., Vol.* 31, *No.* 4, 1994

# STUDY ON THE CHEMICAL COMPOSITION OF BREAST AND THIGH MUSCLE TISSUES IN DIFFERENT BREEDS OF POULTRY

M. Zubuir Siddiqi, A.H. Gillani, Ahsun-ul-Haq & M.E. Habar
*Department of Poultry Husbandry, University of Agriculture, Faisalabad.*

The present study was conducted to provide basic information on differences in meat quality traits of different breeds of poultry i.e. White Leghorn, White plymouth Rock and Lyallpur Silver Black and rural chicken at 12 weeks and spent layer age. The results indicated that age had a non-significant effect on crude protein content of muscles. The significant differences were observed between various breeds. The age also had no effect on ether extract but significant differences due to breed and location were observed. The age and breed affected significantly but location had no effect on ash content of muscle tissues. The chemical score for meat protein of Desi, Lyallpur Silver Black, White Plymouth Rock and White Leghorn was 13.00, 23.00, 18.66 and 23.33% respectively. The thigh and breast muscles of Desi breed had the lowest calcium content of all the breeds.

## INTRODUCTION

Considerable increase has occurred in the production of poultry meat in many areas of the world including Pakistan during the recent past. The main emphasis has been to increase growth through improved heredity and environmental conditions. This has led to achieve the most rapid quantitative gain in weight without consideration for various qualitative parameters. Such efforts have also increased the per capita consumption of poultry meat from 0.23 kg in sixteens to 1.08 kg in 1989 in our country.

Little attention was given to meat quality until the mid nineteenth century when fundamental meat research was first initiated. Since that time numerous research workers have approached the problems of meat production and quality improvement from different angles. They have made many important contribution, the world over (Twining *et al. 1978;* Duranti and Cerletti, 1980 and Harnrn and Searcy 1981). However, work on these lines has not gained much appreciation in Pakistan till today. A need therefore existed to study the differences in the meat quality traits of different breeds of poultry reared in Pakistan including rural chicken at different ages. This will ultimately provide basic information required for quality meat production in our country.

## MATERIALS AND METHODS

The birds of four different breeds i.e., Desi (rural chicken), Lyallpur silver Black (LSB), White Plymouth Rock (WPR) and White Leghorn (WLH) were utilize to study the muscle composition at two stages of life, i.e., at the age of 12 weeks and at spent layer age (one and a half year).

About 100 hatching aggs each of LSB, WPR, WLH were procured and incubated at Poultry Research Station, University of Agriculture, Faisalabad. The hatched chicks were inoculated against

NDV intraocularly. These chicks were reared independently in separate pens on a commercially available chick starter mash. After 8 weeks of age these chicks were shifted to grower ration which was continued till the onset of production. Commercially available layer ration was then fed upto one year of production cycle. During the course of this period, the birds were also protected against different diseases and parasitic infestations. The open shed housing system was adopted and the birds were kept on floor throughout the experimental period.

Fertile eggs of Dcsi breed were procured from the rural areas of the Faisalabad District. About 100 properly selected hatching eggs of Desi breed were hatched under broody hens and the chicks were brooded with broody hens under the prevalent rural conditions. These birds were raised under the traditional management and feeding conditions as this breed is being raised as scavenger in rural areas.

At the age of 12 weeks and at spent layer age (one and half year). Three birds from each breed were randomly picked, slaughtered and dressed. The samples of lean meat of the individually dressed birds at 12 weeks of age and at spent layer age were drawn from breast and thigh regions. The muscle tissues of individual bird were minced separately and samples were preserved for the study of chemical analysis.

Protein, ether extract and ash: The nitrogen was estimated in fresh meat samples by the usual Kjeldahl method and the protein content of the meat were worked out by the formula N2 x 6.25. Muscle tissues were also analyzed for ether extract content with the help of Soxhlet's method using ether as solvent. The ash contents of muscle tissues were determined in muffle furnace at 600' C and the weight of ash was recorded (AOAC, 1980).

Amino acids: Amino acid composition of the selected thigh sample of 12 weeks old chicks were determined (Spackman *et al.* 1958) using EEL automatic amino acid analyzer at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. The samples were hydrolyzed with 6N hydrochloric acid in a sealed glass tube for 24 hours at 100' C under vaccum. The hydrolysate was then dried at 40' C to remove excess of acid under vaccurn, using rotary evaporator. The dry residue was dissolved in a Known quantity of sodium citrate buffer (pH 2.2) and filtered to get a clear solution of hyrolysatc An aliquot was applied on the basic, acidic and neutral columns of the analyzcr. Acidic, neutral and basic amino acids were eluted with a sodium citratc buffer at pH 3.25, 4.25 and 5.28, respectively. The elation was done at a now rate of 15 and 30 ml per hour for ninhydrin and citrate buffer, respectively. The amino acid contents were calculated from peak areas recorded on a specific chart with reference of standard records obtained. from the same instrument.

Minerals: Meat samples for mineral analysis were digested with 1:4 v/v mixture of perchloric acid (60 percent) and nitric acid (70 percent). The dilution was made with dcionizcd water. Macro and micro nutrient elements viz., calcium, phosphorus, potassium, magnesium, iron, maganese, zinc and copper were determined using Pye Unicam (Sp *29(0)* Atomic absorption spectrophotometer, at the Ayub Agricult ural Research Institute (AARI), Faisalabad. The total mineral content were also determined by igniting the' sample at about 550' C (AOAC, 1980).

## RESULTS AND DISCUSSION

Proximate composition of muscle tissues. The proximate composition of thigh and breast muscle tissues of various breeds at chick and spent layer ages i.e. 12 weeks and one and half year respectively are presented in Table 1.

a) Crude Protein: The data on crude protein for the thigh and breast muscles of four different breeds and age ~roups were arranged in two way (Breed x Age)' Table' with three replicates in each sub-class.

Table 2. Paired comparison or crude protein contents or muscle tlssue according differenl breeds, .

| S.O.V. | D.F. | S.S. | M.S. | F. Ratio |
|---|---|---|---|---|
| Between ages | 1 | 0.94 | 0.94 | 2.54I'I:S |
| Between breeds | 3 | 6.71 | 2,45 | 6.05 ■ |
| Age x breed | 3 | ~.76 | 0.25 | O.68NS |
| Error | 8 | 2.98 | 0.37 | |

| Breed | Dcsi | UiB | WPR | WUI |
|---|---|---|---|---|
| Means | 22.'J5'b | 2J.(.(.h | 23.101a | 2J.88b |

Table 1. Percent proximate components of thigh and breast muscle tissues of various breeds at different ages.

| Breeds | Location | Chicks | | | Spent layers | | |
|---|---|---|---|---|---|---|---|
| | | Crude protein | Ether extract | Total ash | Crude protein | Ether extract | Total ash |
| Dcsi | Thigh | 22.39 | 2.(i2 | 1,95 | 23.1H | 2.5H | 1,45 |
| | Breast | 22.59 | 2.(iR | 1,1\4 | 23.fi2 | 2,42 | 1,40 |
| LSB | Thigh | 21.29 | 3J13 | 1,R3 | 21.5R | 2,87 | 1.8fi |
| | Breast | 21.15 | 2.RO | 1.fiR | 22.W | 2.71 | 1,90 |
| WPR | Thigh | 23.40 | 2.75 | 1,93 | 22.31 | 2.70 | 1,46 |
| | Breast | 23.02 | 2.71 | 1,90 | 23.84 | ?51 | 1,48 |
| WLH | Thigh | 21.00 | 3.06 | 1,47 | 22.17 | 2.84 | 1,82 |
| | Breast | 22.45 | 2.72 | 1,54 | 21.88 | 2.04 | 1,90 |

The results of statistical analysis revealed that the age has a non-significant effect on crude protein contents of muscles although apparently the layers had higher percentage as compared to chicks. However, significant differences (P$0.05) were observed between different breeds Table 2. The Duncan's multiple range test revealed a non-significant between WPR and Desi and between LSB and WLH breeds. The differences among all other pairs were significant. .

The data on protein content of muscle tissue revealed significant difference among breeds. Similar results regarding breed differences for protein content between Cobb and Hubbard birds were reported by (Twining *et al. 1(78).* However, age of the bird did not show any significant effect" on protein content of meat. . The present study did not reveal any significant difference in meat composition due to location i.e, thigh or breast. . Duranti and Cerlctti (19RO) also reported minor variations in meat composition from

different locations of the body. However, the values for meat protein reported in the literature were comparatively lower than those observed in this study. These differences may be due to breed or different environmental conditions under which the birds were reared.

b) Ether extract: The data on ether extract were classified according to breed and location ignoring the age because the age had a non-significant effect on contents of muscle tissue. The results revealed that the thigh muscle tissues had significantly (P~O.05) higher ether extract contents than breast muscle tissues Table 3.

Table J. An:llysis or variance or the datll on ether extract contents or muscle tissues according to locatlons and breeds

| S.D.V. | D.F. | SS | M.S. | F, Ratio |
|---|---|---|---|---|
| Between ages | 1 | 0.10 | 0.10 | 11,11 ** |
| Between breeds | 3 | 0.30 | 0.10 | 11,11 ** |
| Age x local ion | 3 | (1.03 | 0,0( | 1,11 ns |
| Error | 8 | 0.07 | 0.00') | |

| | Desi | I,5B | \VI'R | WUI |
|---|---|---|---|---|
| Breed Means | 2.58[3] | 2.85[b] | 2.69[3] | 2.92[b] |

Highest ether extract values were observed in the muscle tissues of White Leghorn and next in order were Lyallpur Silver Black birds, although the differences between these two breeds were non-significant. The differences between White Plymouth Rock and Desi breeds were also non-significant and the ether extract values in the muscle tissues of these two breeds were significantly (P~O.Ol) lower than that of White Leghorn and Lyallpur Silver Black Breeds.

The results indicated significant differences due to breeds and location on ether extract content of muscle tissues. However, age of the birds did not show significant effect on lipid contents of lean muscle tissues. Hamm and Searcy (1981) also reported different in the fat content of breast and thigh meat in commercial broilers. As regard breed differences Twining *et al.* (1978) found differences in fat contents between Cobb and Hubbard birds.

c) AS!1Contents: The data on total ash content of muscle tissues were classified according to breed and location. The statistical analysis indicated non-significant differences between locations. The data were thus tabulated according to breed and age groups. The analysis of variance showed significant (!':50.0l) differences between age groups Table 4. The total ash contents in muscle tissues of<'chicks were significantly higher than that of the spent layers,

Tahle04. Analysis or varianre or the data on ash content or muscle tissues according to hreedv and .ll:l:l J!ruups

| S.O.V. | D.F. | S.S. | MS | F. Ratio |
|---|---|---|---|---|
| Between 3ges | 1 | *0.00473* | *0.00473* | 14.78 "" |
| Between breeds | 3 | 0.0603 | 0.0201 | 6.28 " |
| Age x location | 3 | 0.5133 | 0.1711 | 53,47"" |
| Error | 8 | 0.0256 | 0.0032 | |

Significant (P:50.05) differences between various breeds were also observed. The ash content in the mucle tissues of Lyallpur Silver Black were significantly higher than White Plyouth Rock, White Leghorn and Desi birds. The differences among the later breeds, however, were statistically non-significant.

d) Amino acid: The amino acid spectrum of thigh muscle of young chicks is presented in Table 5.

Table S. Amino acid spectrum of poultry thigh muscle tissue in different breeds of chicks (!!./lOO!!of meal)

| Amino acids | Breeds | | | |
|---|---|---|---|---|
| | Desi | LSB | WPR | WLII |
| Thrcomine | 0.75 | 0.91 | 0.77 | 0.90 |
| Serine | 0.64 | 0.68 | 0.70 | 0.76 |
| Valine | 1,05 | 0.14 | 1,12 | 1,16 |
| Methionine | 0.39 | 0.00 | *O.S(.* | 0.70 |
| Isoleucine | 1,16 | 1,05 | 1,09 | 1,L3 |
| Leucine | 1,80 | 1,84 | 1,98 | 2,00 |
| Phenyle-alanine | 1,13 | 0.99 | 1,09 | 0.95 |
| Lysine | 1,64 | 1,86 | 1,96 | 2.00 |
| Ilistidine | 0.81 | 0.95 | 0.77 | 0,8') |
| Arginine | 1,22 | 1,23 | 1,18 | 1,22 |
| Glutamic arid | 1,(,') | 1,82 | 1'(,3 | 1,')2 |
| Protein | 3.27 | 3,33 | 3.28 | 3,64 |
| Glycine | 0,79 | 0,33 | 0.52 | 0,49 |
| Alanine | 0,94 | 0,80 | 0.77 | 0,')2 |
| Tyrosine | 0.78 | 0.71 | 0,74 | 0.80 |
| Total | 19.19 | 19.35 | ]9,18 | 20.67 |

Among the essential amino acids methionine was 0.39, 0.69, 0.56 and 0.70 g/l00 gms of meat tissue in Desi, Lyallpur Silver Black, White Plymouth Rock and White Leghorn breeds, respectively. The data showed about 56 percent increase in methionine content of Lyallpur Silver Black meat over meat of Desi breed. A slight increase in the lysine contents among these two breeds was also observed.

Chemical score for the meat tissue protein of the breeds under study was worked out by the formula of Oser (1951). The chemical score for the meat protein of Desi, Lyallpur Silver Black, White Plymouth Rock and White Leghorn was 13.00, 23.00, 18.66 and 23.33 percent, respectively. Desi breed has the lowest chemical score while White Leghorn and Lyallpur Silver Black had the highest.

It was observed that the essential amino acid contents of meat were more than 50 percent of the total amino acids in thigh muscle tissues of different breeds under study. The breed differences for different amino acids in thigh meat were also observed. Similar findings were reported by Popa *et al. (1978).*

c) Mlneruls: The concentration of various mineral elements of thigh and breast muscle tissues of young chicks belonging to different breeds arc shown in Table 6. The thigh as well as breast muscle tissues of Desi breed showed the lowest calcium content of all the breeds under study. The Lyallpur Silver Black showed highest calcium and phosphorus content both in thigh and breast muscle tissues of all the breeds. The data on sodium and potassium did not show much variability among different breeds. But these two elements were higher in thigh muscle tissues than in breast muscle tissues in all breeds. Copper and manganese did not show much variability in thigh and breast muscles of chicks of various breeds.

The concentrations of vanous mineral elements of thigh and breast muscle tissues of spent layers of different breeds are shown in Table 7.

Different mineral elements of meat tissue showed variability due to breeds, location and age. Species, breed and strain differences have also been reported by Jacob and Nair (1975) and Hamm and Searcy (1981). In the present study differences in the mineral composition of meat due to age were also noted. Age effects have also been reported by Ranawccra and Wise (1982) and Maynnik *et Al. (1982).*

Table 6. Mineral element contents of thigh and breast muscle tissues of various breeds of chicks.

| Breeds/ Location | Ca % | P % | Na ppm | K mg/kg | Zn mgjkg | Fe mgjkg | Cu mgjkg | Mn mgjkg |
|---|---|---|---|---|---|---|---|---|
| Desi | | | | | | | | |
| Thigh | 0.010 | 0.19 | 725.0 | 3550.0 | 2.031 | 1.965 | 0.025 | 0.118 |
| Breast | 0.010 | 0.25 | 425.0 | 3525.0 | 1.833 | 1.306 | 0.025 | 0.061 |
| LSB | | | | | | | | |
| Thigh | 0.015 | 0.29 | 650.0 | 3350.0 | 1.802 | 2.164 | 0.074 | 0.029 |
| Breast | 0.014 | 0.32 | 350.0 | 3330.0 | 1.644 | 1.165 | 0.074 | 0.029 |
| WPR | | | | | | | | |
| Thigh | 0.012 | 0.24 | 500.0 | 3475.0 | 2.068 | 2.707 | 0.173 | 0.139 |
| Breast | 0.012 | 0.19 | 425.0 | 3175.0 | 1.508 | -0.960 | 0.049 | 0.045 |
| WLH | | | | | | | | |
| Thigh | 0.013 | 0.15 | 650.0 | 3700.0 | 1.903 | 2.000 | 0.155 | 0.061 |
| Breast | 0.015 | 0.26 | 390.0 | 2775.0 | 1.620 | 1.235 | 0.148 | 0.029 |

Table 7. Mineral element contents of thigh and breast muscle tissues of various breeds of spent layers.

| Breeds/ Location | Ca % | P % | Na ppm | K mgjkg | Zn mgjkg | Fe rug/kg | Cu mg/kg | Mn mgjkg |
|---|---|---|---|---|---|---|---|---|
| Desi | | | | | | | | |
| Thigh | 0.013 | 0.17 | 1715.0 | 41.5 | 2.038 | 2.997 | 0.148 | 0.137 |
| Breast | 0.015 | 0.20 | 1605. | 50%.5 | 1.880 | 1.527 | 0.173 | 0.079 |
| rsa | | | | | | | | |
| Thigh | 0.017 | 0.26 | 2050.0 | 5278.0 | 2.211 | 1.960 | 0.248 | 0.118 |
| Breast | 0.015 | 0.19 | 1860.0 | 5005.0 | 1.956 | 1.527 | 0.223 | 0.014 |
| WPR | | | | | | | | |
| Thigh | 0.0092 | 0.18 | 1515.0 | 5096.0 | 2.1297 | 1.927 | 0.099 | 0.045 |
| Breast | 0.0092 | 0.20 | 1375.0 | 5050.0 | 2.061 | 1.452 | 0.198 | 0.045 |
| LH | | | | | | | | |
| Thigh | 0.015 | 0.18 | 2450.0 | 5187.0 | 2.335 | 2.000 | 0.248 | 0.079 |
| Breast | 0.012 | 0.21 | 1420.0 | 51X7.0 | 1.971 | 1.527 | 0.173 | 0.045 |

## REFERENCE


AOAC. 1980. Official Methods of Analysis. 12th Ed. Association of Oflical Analytical Chemists, Washington 4 DC.

Duranti, M. and P. Ccrlctti. 1980. Chemical composition and nutritional value in vitro of mechanically deboned poultry meat. Brit. Poultry Sci. 21: 1-7.

Hamm, D. and G.K. Searcy. 1981. Mineral content of commercial samples of mechanically deboned poultry meat. Poultry Sci. 60: 686-(j88.

Have, RG., M. Ten and C.W. Scheele. 1981, A comparison of the effects of different nutritional factors on the carcass composition of three broiler strains at two ages. In "Quality of Poultry Meat". pp: 38(j-396. Spelderholt. Inst. Poul. Res. Netherlands.

Jacoh, E.T. and S.G. Nair. 1975. The chemical composition and differential distribution of muscle fibres in the pectorals and biceps femoris muscle of chicken and ducks. Indian Vet. J. 52(3): 175-180.

Maynnik, E., M. Reeben and L. Lepaie. 1982. contents of phosphorus, Iron and Copper in poultry products. Mayasnaya Industriya, SSSR. 1: 38-40.

Oscr, RL. 1951, Method for integrating essential amino acid content in the nutritional evaluation of protein. J. Amer. Dietetic Assoc. 27(5): 3%.

Popa, G., M. Mihai, D. Curca, L.M. Buruiana and E. Cernaianu. 1978. Aminoacid contents of game meat. Lucrari stitintifice, Institute Agronomic N. Balcescu, C. 20/21: 165-170.

Ranawcera, K.N.P. and D.R. Wise. 1982. Age associated changes in sodium, potassium and moisture contents of turkey skeletal muscles and note on the effects of testosterone and 17-B Oestradiol. Brit. Poultry Sci. 23: 195-19H.

Spackman, D.H., H. Stein, and S.Moore. 1958. Automatic recording apparatus for use in the chromatography of aminoacids. Anal. Chcm. 30: 111)().

Twining, P.V. Jr., O.P. Thomas and E.H. Bossard. 1978. Effect of diet and type of birds 0 the carcass composition of broilers at 28, 49 and 59 days of age. Poultry Sci., 57: 492-497.