Effect of Dietary Protein and Energy Level on Proximate Composition of Breast and Thigh Meat in White Leghorn Layers at Molt and Post Molt Production Stages

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ABSTRACT
An experiment was conducted to explore the effects of varying protein and energy levels in molt diets on meat composition of White Leghorn layers. One hundred and fifty four, 70 weeks old, layers were randomly divided into 18 experimental units of 8 hens each in addition to 10 birds that were slaughtered at pre molt and post fast stages. After 10 days of fasting during molting, 6 experimental diets having 3 levels of crude protein (CP) i.e. 14, 16 and 18% and 2 levels of metabolizable energy (ME) i.e. 2700 and 2900 kcal/kg were given to the birds at the rate of 45 g/bird for 25 day. There after the birds were offered ad-libitum layer ration during production phase. Two birds per replicate at post molt, at 50% egg production and at the end of experiment were slaughtered and then breast and thigh meat samples were analyzed for proximate composition. Moisture (71.7 and 70.0%) content was significantly (P<0.05) higher while, ether extract (2.13 and 3.49%) was significantly (P<0.05) lower in both breast and thigh meat, respectively, with 18% CP diet as compared to 14 and 16% CP diets. Medium Protein-High Energy (MPHE) molt diet having 16% CP with 2900 kcal/kg ME produced more dry matter and protein content in meat at the expense of ether extract. Results regarding proximate composition of layer meat determined at different stages of molting and post molt production revealed that moisture and protein contents of both breast and thigh meat were significantly increased where as, ether extract and ash contents were significantly decreased at post fast stage with respect to other stages.

INTRODUCTION
Poultry meat being a high quality animal protein source plays significant role in maintaining the health and nutrition of the people (Shahzad et al., 2011). Along with broilers, 35.4 million spent birds (27.4 million layers and 8.0 million breeders) are also being used at the end of egg production cycle contributing more than 46,000 metric tones of poultry meat per annum in Pakistan (Anonymous, 2009; Mahmud et al., 2011). However, with the introduction and adoption of induced molting technique by most of the poultry farmers (Akram and Rehman, 1998), spent bird’s meat is available after two production cycles. Different methods have been used to induce molting but feed deprivation with or without water and light restriction remains the most widely utilized method because it is simple, practicable and economical (Yousaf and Ahmed, 2006).

During post fast stage of molt, various feeding regimens like 12.4, 13.5, 14.8 or 17.0% crude protein (CP) molt diet (Hoyle and Garlich, 1987), corn supplemented with corn gluten feed, and spent hen meal (Koelkebeck et al., 2001), corn, 14.0, 16.0 or 18.0 CP with 2700 and 2900 kcal/kg metabolizable energy (ME) molt diets (Zia et al., 2000), use of probiotics with restricted feeding (Khajali et al., 2008), use of calcium in low energy diet (Dickey et al., 2010) and use of distillers dried grains with soluble (Mejia et al., 2011) have been recommended to induce molt. However, the optimal levels of CP and ME in molt diet, during post fast phase of molt, are still controversial.

In most of the experiments, the effect of different molt diets on egg quality parameters have been studied...
extensively (Koelkebeck et al., 2001; Yousaf and Ahmed, 2006; Khajali et al., 2008; Mejia et al., 2011), whereas its effect on meat quality of the bird has been neglected despite realizing the contribution of spent birds in total poultry meat production. In some of the studies conducted so far, changes in meat composition have been observed during molt induction process and at different stages of post molt production cycle (Akhtar, 1996; Akram, 1998; Zia et al., 2000). During molting period, birds mobilized body fat which reduced to minimum at post fast phase (Zia et al., 2000). Dry matter (DM), EE and ash contents of breast and thigh meat reduced to minimum at early post molt stage. However, these contents were increased at peak production stage and were found maximum at pre molt stage (Akhtar, 1996). But protein content of the meat increased to maximum at post fast stage and then decreased gradually (Akram, 1998). Tang et al. (2007) noticed significant interaction of dietary ME and lysine on weight and yield of breast muscle and were of the opinion that different concentrations of dietary ME and lysine might be considered to improve meat quality.

Although various nutritional regimens have been adopted during induced molt but the information regarding effects of varying CP and ME levels in molt diet on meat composition of the hens was scanty. Therefore, present study was under-taken to determine the impact of different CP and ME levels of molt diets on proximate composition of breast and thigh meat of molted layers.

MATERIALS AND METHODS

One hundred and fifty four White Leghorn Single Comb (WLHSC) hens of a commercial strain (Euribrind), 70 weeks old having uniform body weight (1.48±0.03 kg), were housed in individual cages at Poultry Research Farm, University of Agriculture, Faisalabad. The study was conducted during the winter and spring seasons (from October to April) when the stress of heat was minimum. These hens were given 7 days for adjustment period. During this period hens were provided ad libitum layer ration and water with 24 hours light and were dewormed, vaccinated against Newcastle Disease and given antibiotics to prevent them from secondary infection. At the end of adjustment period 5 birds were randomly selected, slaughtered and dressed by defeathering through warm water scalding. The meat samples were then drawn from both sides of breast and thigh meat of molted layers.

RESULTS AND DISCUSSION

Results regarding proximate composition of breast and thigh meat as affected by various protein and energy levels of molt diets are presented in Table 2. There were significant (P<0.05) differences in moisture, protein and EE contents of breast meat, and moisture and EE contents of thigh meat with respect to various dietary protein levels. Whereas, the effect of different energy levels was found to be significant (P<0.05) only on ash content of thigh meat. Unfortunately, the linear and quadratic effects of protein levels on the response variables could not be observed in the study.

Moisture content: Maximum moisture content of breast (72.8%) and thigh (72.0%) meat at post molt stage were recorded in birds fed 18% protein diet and minimum moisture content of breast (71.7%) and thigh (71.5%) meat were noticed in birds fed 14% protein diet reflecting proportionate increase in meat moisture content with increase in dietary protein. Similar trend were also observed at 50% egg production and at the end of trial. Results of our study are in line with the findings of Mark and Pesti (1984) who observed an increase in water intake in the birds fed on high protein diet. Our results are also in agreement with
Rosebrough et al. (1999) who reported an increase in moisture percentage of carcass of birds fed high protein diet with the argument that high protein diet reduces lipogenesis in the liver and leads to the reduction of fat deposition in muscles and therefore, decrease the overall dry matter percentage of meat. Higher moisture content in carcasses of birds fed high protein diet compared to the birds fed low protein diet has also been observed in other studies (Ferket and Sell, 1990). However, non-significant differences were reported by Results regarding effect of dietary protein and energy interactions on moisture content of meat at post molt stage showed significantly higher moisture content (73.0 and 72.1%) with HPHE diet whereas, significantly lower values of moisture (71.6 and 71.4%) were noticed with LPHE diet in breast and thigh meat, respectively. Similar trend was also seen at 50% egg production and at the end of trial. 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Non-significant changes in protein content of thigh meat with respect to various dietary treatments were observed probably due to lesser protein content of thigh meat.

Among stages, maximum protein content of breast and thigh meat was recorded at post fast stage and minimum protein content at post molt stage (Fig. 1b). However, after post molt stage there was significant increase in protein content of breast and thigh meat at 50% egg production stage as well as at the end of trial. This highest protein content in both breast and thigh meat at post fast stage was due to depletion of fat and ash contents of meat as a result of fasting. With the resumption of restricted feeding after fasting there was increase in mostly the fat content of the meat that resulted in decreased percent protein of the meat at post molt stage. Then with the provision of ad libitum layer ration after molting there was increase in protein percentage of breast and thigh meat at post fast stage compared to post molt stage.

**Ether Extract content:** The differences among ether extract (EE) content of breast and thigh meat as affected by different dietary protein levels and at various molt and production stages were statistically significant (P<0.05). However, the effect of dietary energy levels on EE content was non-significant. Diet containing 14% CP resulted in higher EE percentages of breast and thigh meat whereas, lower values of EE content were observed with 18% CP diet indicating an inverse trend between EE content of the meat and dietary protein levels. Rama Rao et al. (2004) also found an inverse relationship between the levels of dietary protein and EE content of the meat and speculated that an increase in dietary protein level decreased the flow of substrate (acetic acid) through glycolysis and increase the production of glucose from substrates that were formally in the pathways leading to fat synthesis. Effect of dietary protein and energy interaction on EE content showed significantly (P<0.05) higher EE content of thigh meat in birds fed on LPHE diet and significantly (P<0.05) lower EE content with HPLE and MPHE diets. It reflected that diet having low protein with higher calorie: protein ratio resulted in more EE content in meat as compared to high protein diet with lower calorie: protein ratio. These results are also supported by the findings of Edwards and Denman (1975) who reported that low protein diet with wider calorie: protein ratio produced birds with more carcass fat than those of high protein with narrow calorie: protein ratio.

Among stages, maximum EE content (2.34 and 3.93%) was observed at pre molt stage whereas minimum EE content (1.90 and 3.21%) was noticed at post fast stage in breast and thigh meat, respectively (Fig. 1c). This drastic decrease in EE content at post fast stage was due to the utilization of body fat to provide energy to the bird during fasting. However after fasting, with the provision of restricted dietary treatments, there was increase in EE content at post molt stage. And thereafter, due to resumption of ad libitum feeding during production period there was increasing trend in EE content of breast and thigh meat at 50% egg production stage and even at the end of trail due to more availability of energy. Significant
The findings of Akram (1998) who also reported a decrease in ash content of breast and thigh meat after fasting and then increasing trend after moulting and at the post molt stage, as compared to the ash content (1.35%) of breast meat. However, the difference became non significant at later stages of production. Among stages, ash content followed the pattern similar to EE i.e. significantly (P<0.05) lower values (1.28 and 1.33%) in breast and thigh meat, respectively after fasting as a result of depletion of ash along with other meat components (Fig. 1d). Then with the resumption of feeding, after fasting, ash content again increased. These results are in line with the findings of Akram (1998) who also reported a decrease in ash content after fasting and then increasing trend thereafter.

In this study, the difference of 1 or even <1% among some of the values of variables has been observed significant. Percentage wise these differences look small. But in the developing countries like Pakistan where huge quantity (46,000 metric tons) of spent birds meat is consumed annually, the significant difference of <1% in moisture or CP values of the meat becomes very important in nutritional point of view.

**Conclusions:** Dietary level of 16% CP may be adequate for hens during molt process and increase over this level (up to 18%) leads to wastage of protein. Molt diet (MPHE) having 16% CP and 2900 kcal/kg ME can be used more efficiently as this diet produced more DM and protein content with less EE in meat.

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