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The effect of commercially available chicken feed and chicken meat on body weight and serum estrogen levels in female albino Wistar rats

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In Pakistan, the most favorable consumption in meat nowadays is chicken. The inclination of the dietary pattern to chicken meat more than red meat may be because of its better taste, easy availability and low cost. At the same time, there is an increase in prevalence of polycystic ovaries 5 to 10% in Pakistan. The present study was designed to investigate the effects of the chicken feed and chicken meat on the growth, body weight and the serum estrogen levels in the female albino wistar rats. Seventy five female albino wistar rats were used in the experiment, randomly assigned to three groups (n=25); control rats fed on chow, chicken feed treated rats and chicken meat treated rats for a period of 6 weeks. Body weight and serum estrogen levels were estimated before and after the treatment whereas growth rates were calculated after the experiment. A significant increase in growth rate and serum estrogen levels (P<0.05) was observed in both test groups as compared to control group. This increase was however more in chicken meat (III) as compared to chicken feed (II) group (p <0.05). It is therefore suggested that the potential cause of weight gain, growth and increased estrogen levels may be result of dietary inclination of people towards chicken meat leading to polycystic ovaries (PCOs) and infertiity.

Key words: Chicken feed, chicken meat, estrogens, growth rate.

INTRODUCTION

The daily consumption of the chicken meat has exceeded that of any other meat product including fish and red meat (Hamano and Kurimoto, 2016). To meet the high chicken demand and supply more and more poultry farms are developed and poultry production is encouraged throughout the nation. In Pakistan the poultry farming is not only a successful business but also small chicken pens are kept in backyards for the house hold consumption (Hamano and Kurimoto, 2016). The chicken normally takes three months time to grow into a broiler, the size fit for its consumption (Marzec et al., 2016). The poultry industry now a day uses feed for the chickens that enable them to grow to a complete size in just one and a half months (Psifidi et al., 2016). The feed given to them are supplemented with many nutritional and non-nutritional products.

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Along with them other additives found in chicken feed are antibiotics, steroids, arsenic and minerals (Gonzalez-Moran, 2015) used purposefully for the better growth and performance of the chickens. The ingredients of the chicken feed are reported to cause better taste and meat size in chickens and hence providing with proteins and fats to the human body. However, the presence of the certain substances especially roxersone, oyster shells from polluted waters, antibiotics, fats from previous chicken remains and hormones additives in the feed concentrate of the chicken meat may bring harmful effects on the individuals consuming the meat (Psifidi et al., 2016). The consumption of the chicken meat will allow the entry of the components of the feed on which the chickens were grown into the body.

The hormonal additives of chicken feed include steroidal sex hormones especially estrogens also known as estradiol (E2). E2 being ovarian hormone is pleiotropic regulator of numerous cellular functions particularly modifying energy balance in the body. However, the understanding on the outcomes and major sites of action of E2 to control metabolism, body weight as well as energy expenditure is still moderately incomplete. Reduced levels of E2 in body are connected with hyperphagia, decreased energy expenditure and weight gain. E2 substitution on the other hand prevents obesity and metabolic impairment by plummeting energy intake and amplifying energy expenditure in the body.

Research also shows that animal derived foods especially chicken products contain certain amounts of E2 in the raw flesh (Qiao et al., 2015; Wang et al., 2011). Even trace amounts of E2 are detected in the animal droppings (Hu et al., 2012). As we know that commercial poultry is reared on the chicken feed containing grains, grit, antibiotics, steroids, hormones like E2 and roxersone for better growth and survival. The present study is designed to observe the effects of administration of raw chicken meat and chicken feed on weight gain, growth rates and serum E2 levels in rats.

MATERIALS AND METHODS

The study was carried out at Baqai Medical University Campus situated on super-highway of Karachi; the largest as well as most densely inhabited city in Pakistan and 7th largest metropolitan city of the world. It is located on the southern coastline along the Arabian Sea of Sindh on coastal plains with extended hills, rocky outcroppings and coastal marshlands. The climate and temperature of Karachi is parched and arid. The latitude and longitude in decimal degrees is 24.8 and 67° respectively with altitude/elevation of 4 m (13 ft). The city has low annual average precipitation levels of approximately 250 mm or 9.8 inch per annum mostly occurring between July and August monsoon seasons. The summers start in March and last in June with highest recorded temperature of 48°C (118°F). The winter climate is dry with lowest recorded temperature of 0°C (32°F) and lasts between December and February. Owing to the proximity to the Arabian Sea the humidity levels are mostly constant throughout the year.

A total of 75 weaning albino rats of average 100 g weight were purchased from the Animal House of the Dow International University, Karachi and were randomly allocated into three groups of twenty five animals each after adaptation. The rats were kept for 12 h day and night cycle with ambient room temperature of 22±2°C at the animal house of Baqai Medical University. The rat chow was obtained from the Baqai University Karachi animal house. Commercially available chicken meat and chicken feed was purchased at a commercial supermarket of Karachi. Group I served as the control given with rat chow as feed; Group II was given commercial chicken feed and Group III was given raw commercial chicken boneless meat. The rats were allowed free access to water and feed *ad-libitum* (Rat chow, chicken feed and boneless meat respectively). Body weight and blood samples of the rats were estimated before commencement and at the end of experiment for the evaluation of growth rates and serum E2 levels respectively in them. The blood collected was centrifuged to separate serum. The serum was then transferred into another set of clean test tube and stored at 4°C until analysis for the evaluation of serum E2 levels.

Serum E2 was measured using E2 Enzyme Immunoassay Test Kit (Catalog Number: BC-1111) following the manufacturer BioCheck Incorporation protocol. The principle of the estrogen enzyme immunoassay is based on the competitive binding between E2 in the test specimen and estradiol-horse reddish peroxidase (E2-HRP) conjugate for a constant amount of rabbit anti-Estradiol. Analysis was done through the instrument spectra junior. The analytical sensitivity was 10 pg/ml and intra and inter assay coefficients of variation was less than 10 and 12 %, respectively.

Data analysis

Data collected from the study was subjected to one-way ANOVA (analysis of variance) using the SPSS version 22. Mean comparison was done by Tukeys HSD test; P values <0.05 were considered significant.

RESULTS AND DISCUSSION

The result from this study revealed significant effect of weight gain of rats treated with commercial chicken meat (Table 1). Post hoc analysis by tukeys HSD test showed that growth rate was significantly increased following consumption of chicken meat and chicken feed for 6 weeks as compared to control. Animals of Group III fed upon chicken meat grew faster as compared to the Group II rats.

Weight gain, growth, and fertility is said to be environmentally impacted. However, fertility is the major parameter of reproductive performance which is also sensitive to genetic influences (Cranney, 2016) and steroidal sex hormone levels in the body. E2 is one of the most important hormones determining successful fertilization. Rats of Group III showed marked increase in both body weight and growth along with serum estrogen levels, consistent with earlier report (Lopez and Tena-Sempere, 2016). E2 controls a number of physiological processes, such as puberty, reproduction, growth, development and metabolic rate (Heidelbaugh, 2016). In fact, estrogen deficiency in organisms under normal and abnormal circumstances may result in increased appetite and reduced energy expenditure leading to weight gain and obesity. Remarkably, diet ensuing high estrogen

Table 1. The effect of intake of chicken feed and chicken meat on body weight and growth rate in rats.

Body weight and growth rate	Control group fed on rat chow	Chicken feed treated rats	Chicken boneless meat treated rats
Initial Body weight (g)	110.0±4.2	96.1±2.2	103.2±3.0
Body weight (g) after six weeks	221.1g±5.4	229.7g±4.1*	252.9g±5.7*+
Growth rate (%) of rats	201%	239%*	245%*+

Growth rate in percentage = final weight/initial weight ×100; Values are mean ± standard deviation (n=25). Significant difference by paired t test; *P<0.01 vs control group fed with rat chow; + P<0.01 vs chicken feed treated rats.

Table 2. The effect of chicken meat and chicken feed on serum estradiol in rats.

Estrogen levels	Control group fed on rat chow (pg/ml)	Chicken feed treated rats (pg/ml)	Chicken boneless meat treated rats (pg/ml)
Baseline values	6.0 ±0.31	5.9±0.30	6.0±0.41
Final values after six weeks	6.7 ±0.46	13.0±1.3*	10.0±0.13*+

Values are mean ± standard deviation (n=25). Significant difference by paired t test; *P<0.01 vs control group fed with rat chow; + P<0.01 vs chicken feed treated rats.

amounts in body reverts the effects of weight loss and growth inhibition as shown in the present study (Tables 1 and 2). The rats of Groups II and III show remarkable increase in the estrogen levels and hence greater weight gain and growth as compared to Group I rats. This was demonstrated by the Post hoc tukeys HSD analysis showing significant raise in serum estradiol levels (P<0.05) in chicken feed and meat fed groups compared to control. The E2 levels of the chicken feed group was (P<0.05) significantly higher than the chicken meat fed group, while weight gain and growth was significantly high (P<0.05) in chicken meat treated group when compared to other groups in the study. This result was once more agreeable with the previous studies summarizing the positive effects of augmented serum E2 on weight gain and growth in the individuals (Jiralerspong and Goodwin, 2016).

This study revealed that commercial chickens reared on commercial feed and commercial chicken meat had increased synthesis and sustained high levels of E2 in the body. This led to increase weight gain and growth rates in these experimental animals. This was however, not seen in control animals. Weight gain, high growth rates and increased E2 in Groups II and III rats was subjected to commercial feed and poultry grown on such feed. It was reported previously that chicken meat and chicken feed contains large ration of proteins, fats and cholesterol. Cholesterol and fat provides precursors for synthesis of hormones and in the body resulting in accelerated growth (Ahmad et al., 2016; Milicevic et al., 2014).It was reported in the present study that growth after treatment with chicken meat was accelerated as compared to chicken feed treatment to rats for six weeks. This can be attributed to the recent increase in the rate of weight gain and obesity in the Pakistani population consuming chicken meat on daily basis (Mushtaq et al., 2013). Chicken meat is selected and consumed largely by general population Pakistan as it is cheap, easily available and considered to be rich in dietary nutrients (Ahmad et al., 2016). Therefore, the population at large is consuming more fats and cholesterol rather than proteins hence gaining weight gain leading to obesity. It was also observed in the present study that serum E2 levels were significantly increased in chicken feed and chicken meat treated rats as compared to controls. This could be attributed to amplified cholesterol levels in the body after such consumption facilitating steroidal hormones synthesis (Cinar et al., 2012). Augmented cholesterol levels enable body to produce more estrogens and other steroidal hormone as reported earlier (Cerqueira et al., 2016). Therefore, increased cholesterol and fat intake results in more cholesterol formation and storage in the body as adipose tissue ensuing increased growth and steroidal hormone E2 synthesis (Psifidi et al., 2016). E2 plays a vital role in the development of secondary sexual characteristics and also maintains integrity of reproductive cycles in organisms. Irregularities in synthesis of E2 production hence leads to altered development of secondary sexual characteristics and inability to acquire sexual maturation and inability to procure off springs (Pulley et al., 2013). In the present study, rats treated with chicken feed and chicken meat showed increase in serum E2 levels. Previous study reported that increase in E2 resulted in prolongation of estrus cycles that may cause irregularity in reproductive cycles and infertility (Narasimhan et al., 2013). Similarly in human females varied E2 levels may also cause irregular and anovulatory cycles (Mehta et al., 2016). The

present experiment suggested that frequent consumption of chicken meat alters E2 levels as well causes weight gain that may lead to obesity in females. Obesity and oscillating estrogens can further lead to cystic formations in ovaries, insulin resistance, hyperlipidemias, hypertension and diabetes (Palioura and Diamanti-Kandarakis, 2013). Amplified E2 in body may become source of proliferation of cells in uterus and breast (Coelingh Bennink et al., 2017). Proliferation of the uterine lining with no release of the follicle leading to the anovulatory cycle and cystic conversions of these follicles (Fanta, 2013). These anovulatory cycles may cause irregularities in menstrual cycle with difficulty in getting pregnant.

This was constituted that the dietary pattern nowadays is resultant of obesity, polycystic ovaries (PCOs), diabetes and many health related disorders linked to hyperlipidemia, insulin resistance and hormonal imbalances.

Conclusions

The current study indicated that the chicken feed and commercial chicken meat increases the weight gain, growth rate and serum E2 levels in the consuming rats. This probably is attributed to the contents that are included in the feed provided to commercial chickens to grow upon. Similar effects are anticipated in the humans who consume commercial chicken on routine basis, hence bringing the deleterious effects on their health in terms of weight gain, growth, obesity and hormonal irregularities-levels that may lead to progression of PCOS and infertility in them.

Conflicts of Interests

The authors have not declared any conflict of interests.

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