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IMPACT OF DIFFERENT FEED RESTRICTION SYSTEMS ON PROFILE ANALYSIS AND GROWTH CURVE OF BODY MASS INDEX IN BROILER

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ABSTRACT

The purpose of this study was to investigate the effect of different feed restrictions on Body Mass Index (BMI) of Ross 308 broiler chickens. Two different statistical methods were used: profile analysis and growth curves. The weekly body weight and weekly body length of chickens was estimated from 2nd week to 6th week of age. Profile analysis was used to compare differences among the groups and the Gompertz growth function was applied to estimate the growth parameters. The group profiles were found parallel in terms of BMI also results revealed that the profiles are coincident, but when the power test was estimated results show that $F = 127.99$, Wilk's Lambda = 0.007 with p-value=0.0002, which means that the differences were significant between the means of BMI across the weeks. According to our results, conclusion may be arising that the difference in BMI of the birds between weeks depends on feeding regime. In order to describe the growth curve of BMI, two statistical methods were used: simple linear regression and Gompertz function. Results obtained that Gompertz function was more fitting the data than linear regression. As there are no significant differences in BMI between groups, the restricted feeding may play an important role in profitability by decreasing the cost of breeding.

KEY WORDS: growth curve, body mass index, Gompertz function, broiler chicken.

INTRODUCTION

Most studies on Body Mass Index (BMI) were conducted in humans to measure obesity (Must *et al*., 1991; Engeland *et al.*, 2007). Obese studies are scant in livestock and poultry, however commercial broiler chickens have an increased growth rate but rapid growth associated with negative effects, including an increase in fat deposition (Griffin, 1996; Zerehdaran *et al.*, 2004). Decreased fat content may be desired in meat products and this can be provided by decreased BMI. Excessive fattening is undesirable for both bird health and meat quality (Shahin and Elazeem, 2005, 2006). Feed restriction or similar stressful situations may make the BMI more acceptable for the health of consumers. As *ad libitum* feeding is common in broiler it is worth to compare the difference between ad libitum and restricted feeding because the results of such comparison could affect the profitability of poultry project. In addition, restricted feeding may increase the meat's market value by improving its leanness in contrast with fattiness. An optimum feeding regime can benefit the producer by shaving the costs related to feeding as compared with *ad libitum* feeding and minimizing the incidence of metabolic diseases. The aim of this study is to investigate the effect of restricted feeding on profile analysis and growth curve in term of BMI in broiler, as the BMI represents an indicator of fat deposition in broiler, which makes broiler undesirable food for consumers.

MATERIALS & METHODS

An experiment was carried out ona poultry farm in College of Veterinary Medicine /University of Baghdad. A total of 40 male day old (Ross 308) chicks were used. The experiment lasted long for 42 days. The chicks were randomly divided into four groups with 10 chicks each and located as follows: (T0) chicks group freely access feed *adlibitum* as a control, the remaining treatments (T1, T2, and T3) chicks were off fed for 8, 16, and 24 hr. a day respectively for 14-35 days of age. All chicks were allowed to access water freely from nipple drinker to satisfy their water requirements. The chicks were assigned to receive 2 kinds of formulated balanced diets (starter and finisher). Diets were designed to meet chicks nutrient requirements included (CP 23% and 3100 kcal/kg feed ME) and (CP 20% and 3000 kcal/kg feed ME) for the two mentioned diets respectively. Barn conditions (temperature, humidity) were kept similar for each group. Initial body weight, body weight change and feed consumptions of chicks were determined by a balance (5 g. by precision). The weekly body weight (g) and weekly body length (cm) of chickens were estimated from 14th days of age to 42 days of age. Body Mass Index (BMI) for each chicken was computed as follows:

BMI = Body weight (g) / (Body length (cm)^2. Blood samples were taken for cholesterol level determination.

Statistical Analysis

Profile analysis and Gompertz growth curve function were used in analyzing data.

Profile analysis was used to determine the magnitude of both within-subjects (week) and between-subject (group) main effects and interactions. In this study, k-sample profile analysis was adapted to compare BMI of Ross 308 broiler chickens raised under three different feeding regimes. This allowed for the assignment of a level of statistical significance differences and the shapes of the centroids of three feeding regimes. Profile analysis is a method of comparison of groups that are experimental units in the same set of p measurements by examining the p-1 slopes using multivariate analysis of variance (MANOVA) between adjacent coordinate values for mean vectors of the groups. Profile analysis is an extension of the repeated measurement and the special case of MANOVA. The basis of profile analysis is a sequence comparison method for finding and aligning distantly related sequences.

Profile analysis included three questions:

1) Were the profiles parallel?

Two other questions, contingent on the answer being "yes" to question (1) were:

2) Were the profiles coincident (*i.e.* identical or superimposed)?

3) were the profiles **level** (i.e. horizontal or flat)?

There were some reasons for the superiority of profile analysis to other methods such as repeated measurements and growth curve (Morrison, 1995; Mendes *et al.*, 2005; Ersoy *et al.*, 2006).

Gompertz Growth function was defined as:

W = A exp [-exp (-b (t-k))]

Where, W is the BMI at the day t; A is the maximum BMI at maturity; b is the rate of growth; k is the age (days) of the maximum daily BMI gain. The analysis was performed separately for each group.

Analysis of data was submitted by the SAS program (2000).

RESULTS & DISCUSSION

Test of parallel profiles obtained that the null hypothesis of parallel profiles is not rejected as F= 2.93, Wilk's Lambda = 0.03 with p-value = 0.67 which means that the interaction between weeks and groups was not significant as shown in (Figure 1). The second null hypothesis investigates whether the profiles are coincident or superimposed on one another. Since the profiles were parallel, one only needs to examine the average (or total) of the p responses for each group level. Hence, the test is univariate. The results obtained that F = 2.63, Wilk's Lambda = 0.33 with p-value =0.18. Therefore, we do not reject the hypothesis of coincident profiles. In order to truly accept the null hypothesis of coincident profiles, the power of the test should be computed (Bergerud, 1995).

The F = 127.99, Wilk's Lambda = 0.007, p-value =0.0002. Therefore, we reject the null hypothesis of equal means of BMI across the weeks.

Results in Table (1) showed that all the differences of BMI due to group effect were not significant but they were significant ($P < 0.05$) due to weeks. These results are disagreeing with Mendes *et al.* (2007) who reported that male broilers freely had higher BMI values compared to male broilers with restricted feeding.

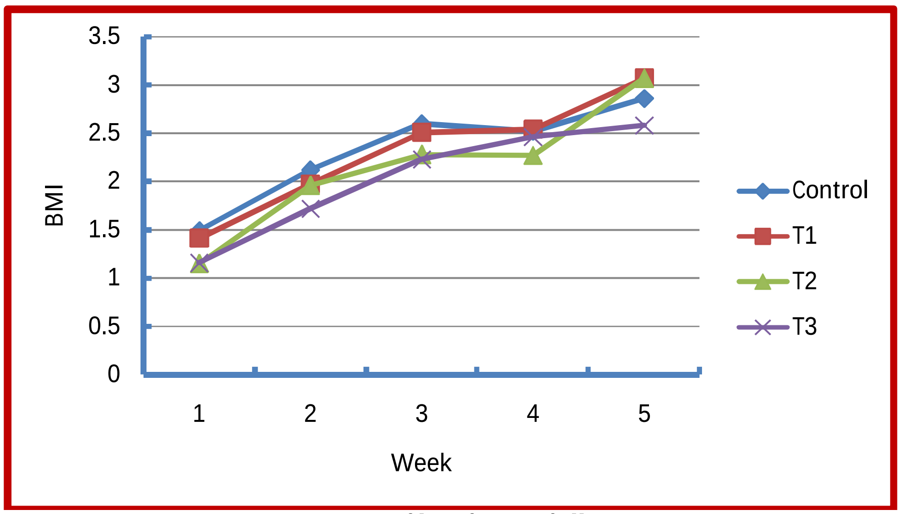

FIGURE 1: Profiles of BMI of all groups

TABLE 1: Means of BMI of groups (control, T1, T2, and T3)

Group	2 weeks	3 weeks	4 weeks	5 weeks	6 weeks
Control	c1.48±0.06	b2.11±0.44	ab2.60±0.08	ab2.52±0.19	a2.86±0.11
T1	d1.40±0.07	c1.96±0.06	b2.51±0.16	b2.53±0.13	a3.07±0.01
T2	c1.15±0.05	b1.95±0.05	b2.28±0.06	b2.27±0.006	a3.07±0.09
T3	c1.16±0.08	b1.71±0.08	a2.23±0.19	a2.45±0.43	a2.58±0.07

Means with different subscript letters in the same row differ significantly ($P < 0.05$)
All differences between groups across weeks are not significant

It's clear from the same table that the means of BMI were increased gradually through 2 and 3 weeks in all groups; whereas the trends of BMI means in the later weeks differ as groups differed.

The fluctuated trends in BMI have been reported by Mendes *et al.* (2008).

Gompertz growth function and linear regression were used to fit the BMI curve of broiler chickens reared under different feeding regimes.

The parameter estimates based on Gompertz growth function are given in Table (2).

TABLE 2: Parameter estimates and growth characteristics of broiler based on Gompertz function

Parameter	Control	T1	T2	T3
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
A	2.84±0.28	3.50±0.62	3.80±1.41	2.75±0.36
b	0.11±0.06	0.06±0.02	0.05±0.03	0.09±0.04
K	10.23±2.71	12.23±2.37	15.84±7.09	12.59±1.99
R	0.98	0.99	0.99	0.98
R /Linear	0.70	0.91	0.89	0.78
MSE	0.086	0.034	0.060	0.069

Estimated parameters A, b and k showed higher values for T2 as compared with other groups. The parameter values of k for T1 and T3 were almost same values. Coefficients of determination (R2) values for all groups were same (98-99 %). The MSE value of T1 was smaller than that of the Control, T2 and T3. The Gompertz functions are illustrated in figures 2, 3, 4, and 5.

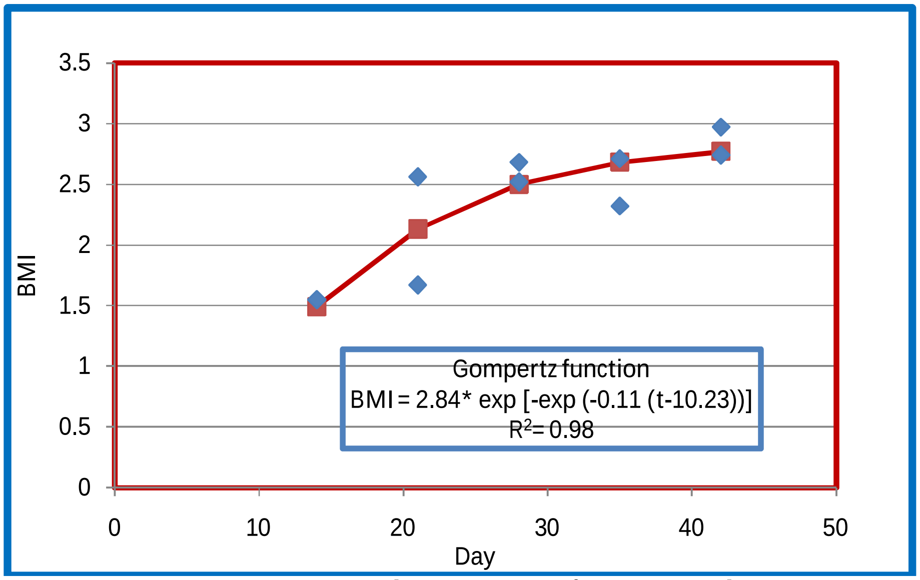

FIGURE 2: Gompertz prediction equation of BMI in control group

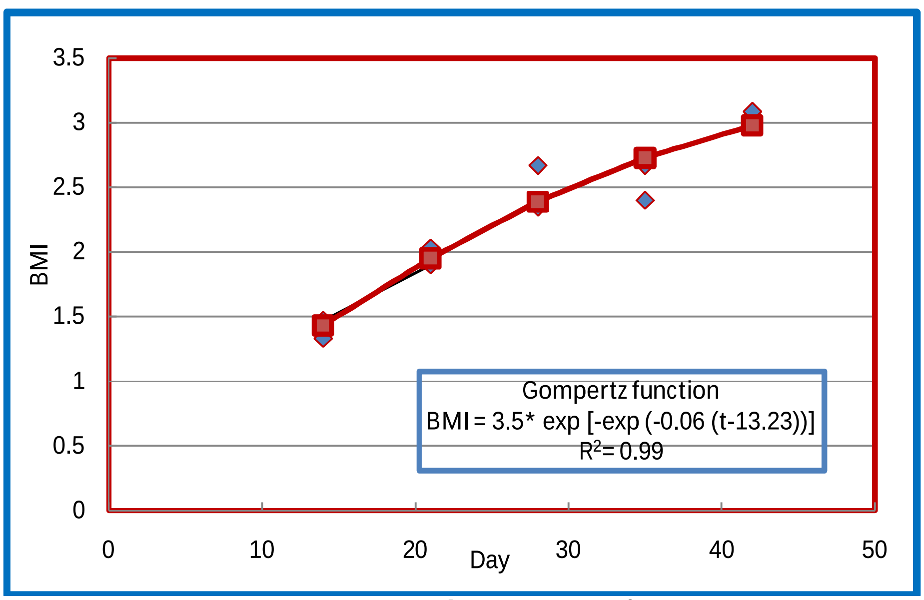

FIGURE 3: Gompertz prediction equation of BMI in T1

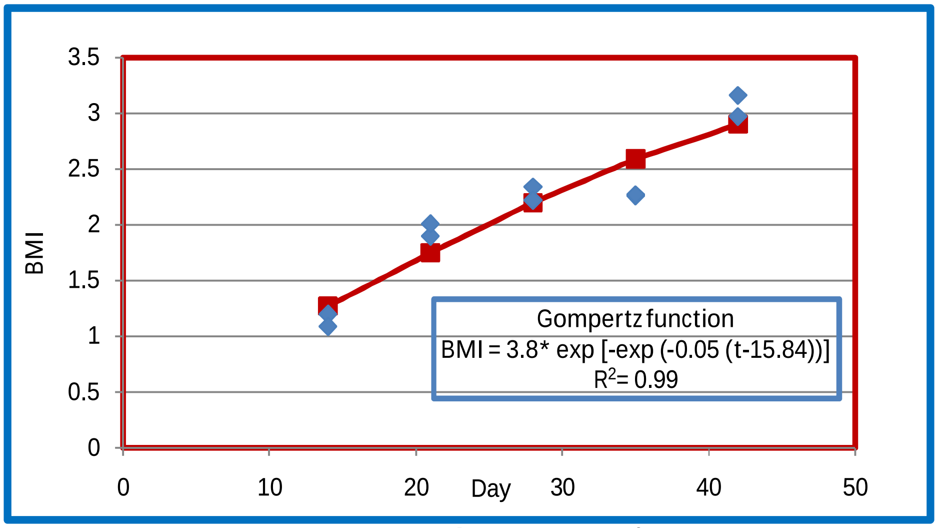

FIGURE 4: Gompertz prediction equation of BMI in T2

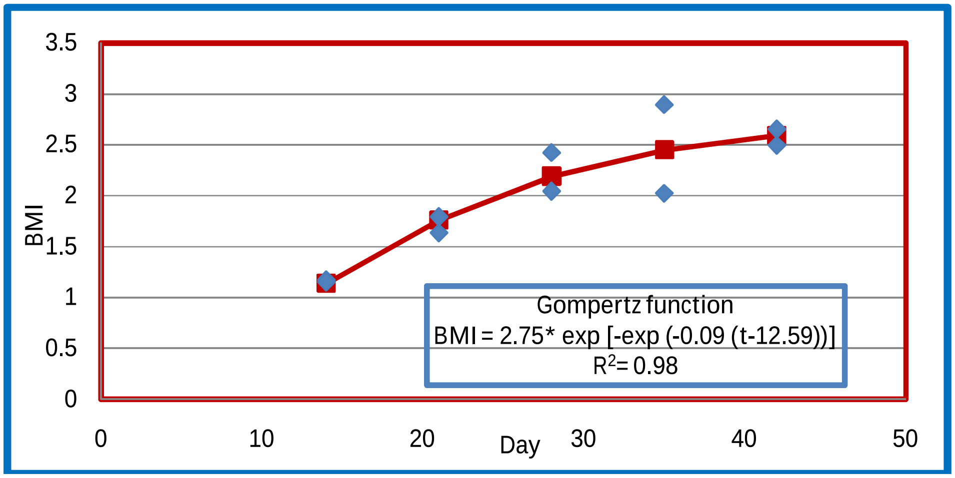

FIGURE 5: Gompertz prediction equation of BMI in T3

Fitting BMI curve using linear regression was illustrated in figures 6, 7, 8, and 9. The R^2 values of the four groups (control, T1, T2, and T3) are 0.70, 0.91, 0.89, and 0.78respectively, whereas the corresponding values of Gompertz function are 0.98, 0.99, 0.99, and 0.98 respectively.

Results revealed that the Gompertz growth function was more powerful for fitting growth curve as compared with linear regression, as all R^2 values of the Gompertz growth function were higher than those of linear regression.

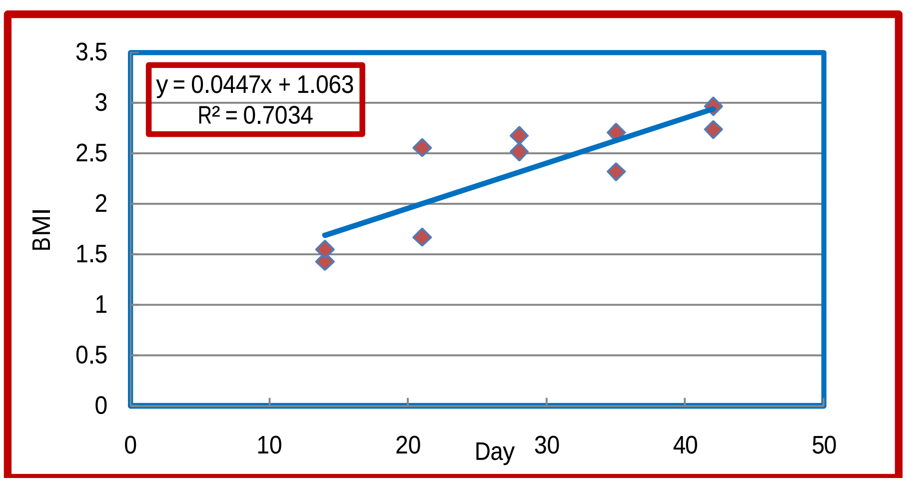

FIGURE 6: Linear prediction equation of BMI in control group

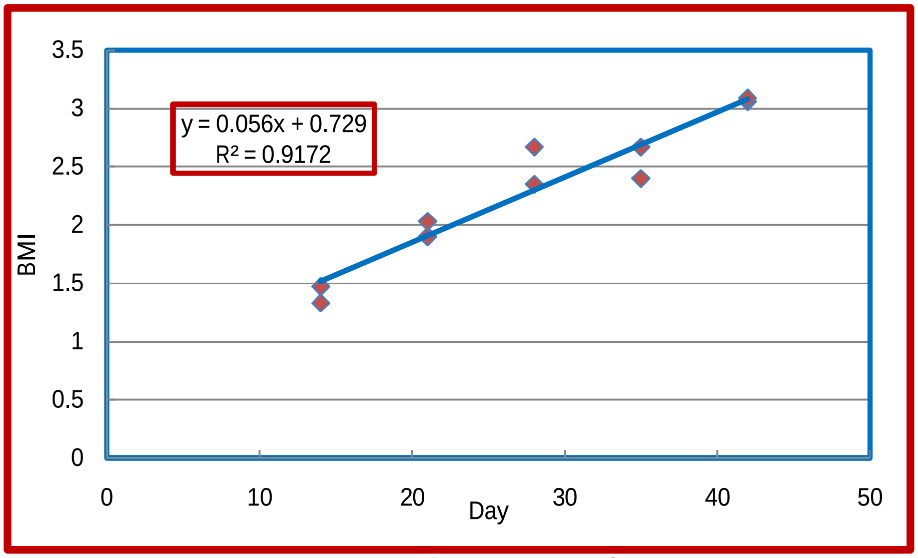

FIGURE 7: Linear prediction equation of BMI in T1

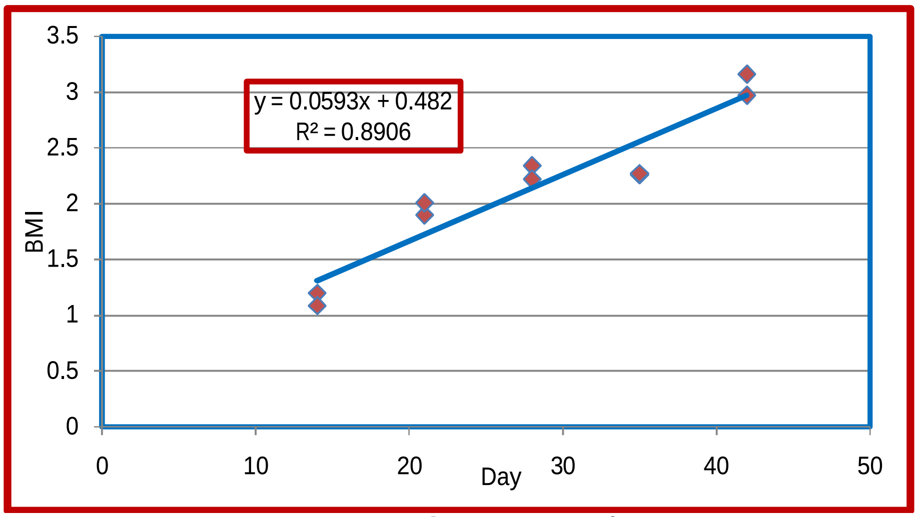

FIGURE 8: Linear prediction equation of BMI in T2

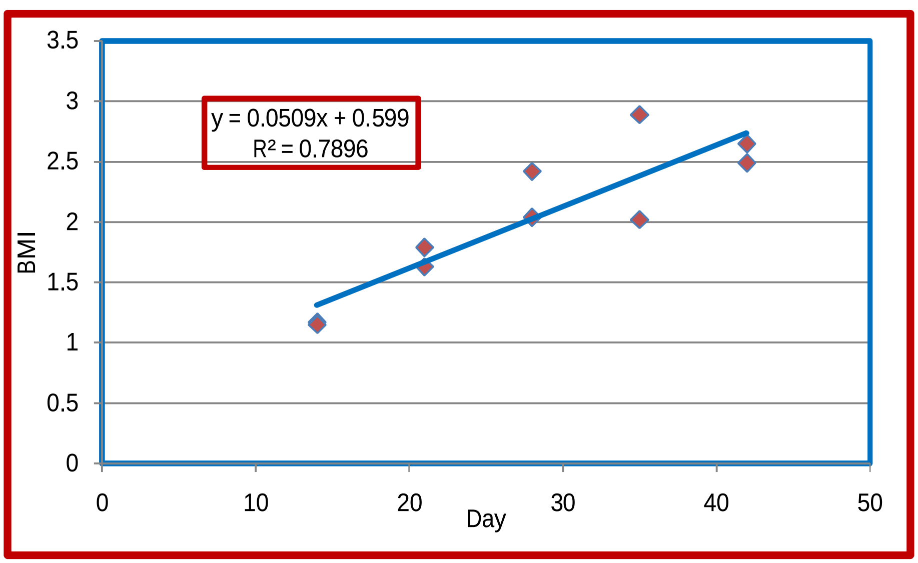

FIGURE 9: Linear prediction equation of BMI in T3

As regards to cholesterol, results revealed that the differences in means belong to weeks that were not significant; whereas the differences were significant ($p < 0.05$) between groups (Table 3). These differences could be a tribute to feed restriction since liver in such feeding could be more able to metabolize the fat.

Results came out of our study revealed that the restricted feeding was not affect the BMI, but such feeding will affects rearing cost surely. In other words: we need to ask: Is applying restricted feeding makes broiler projects more profitable? Conducting subsequent experiments will answer this question, and that is our recommendation.

TABLE 3: Means of cholesterol concentration of groups (control, T1, T2, and T3)

Group	16 day	23 day
Control	a180.96±0.54	a181.5±0.28
T1	a177.66±1.45	a178.55±0.88
T2	b143.66±2.02	b145.33±1.45
T3	c125.50±0.76	c126.00±0.57

Means with different subscript letters in the same column differ significantly (P< 0.05)

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REFERENCES

Mendes, M., Dincer, E., and Arslan, E. (2007) Profile Analysis and Growth Curve for Body Mass Index of Broiler Chickens Reared Under Different Feed Restrictions in Early Age.Arch. Tierz., Dummerstorf 50 (2007) 4: 403-411.

Mendeş,M., Pala, A., and Dincer, E. (2008) Body mass index slopes of growth and fat content under different feed restrictions in broiler chickens.Arch.Geflügelk., 72 (1): 41–45.

Must, A., Dallal, G. E., and Dietz, W. H. (1991) Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht2) and triceps skinfold thickness. Am J Clin Nutr.54:773.

Griffin, H.D. (1996) Understanding genetic variation in fatness in chickens. Annual Report. Roslin Institute, Edinburgh.

Zerehdaran, S., Vereijken A.L.J., Ereijken, Vanarendonk , J.A.M. and Vanderwaaij, E. H. (2004) Estimation of genetic parameters for fat deposition and carcass traits in broilers. Poultry Science 83: 521-525.

Shahin, K. A. and Elazeem, F.A. (2005) Effects of breed, sex and diet and their interactions on carcass composition and tissue weight distribution of broiler chickens. Arch. Tierz., Dummerstorf 48: 612-626.

Shahin, K.A., Elazeem, F.A. (2006) Effect of breed, sex and diet and their interactions on fat deposition and partitioning among depots of broiler chickens. Arch. Tierz., Dummerstorf, 49: 181-193.

Engeland, A., Tretli, S., Hansen, S., Bjorge, T. (2007) Height and body mass index and risk Lymphohematopoietic Malignancies in two million Norwegian men and women. American Journal of Epidemiology, 165: 44-52.

SAS (2001) SAS/STAT Users Guide for Personal Computer. Release 6.18.SAS Institute, Inc., Cary, N.C., USA.

Bergerud, W.A. (1995) Post-hoc power analyses for ANOVA F-tests. Biom. Info. Pamph. 52. Res. Br. B.C. Min. For., Victoria, B.C.

Morrison, D.F. (1995) Multivariate statistical Methods. Third edition. New York: McGraw-Hill Publ.

Ersoy, I.E., Mendes, M., Aktan, S. (2006) Growth Curve Establishment for American Bronze Turkeys. Arch. Tierz., Dummerstorf, 49:293-299.