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EFFECT OF USING CUMIN OIL (*Cuminum cyminum*) AS FEED ADDITIVES ON PROFILE ANALYSIS AND GROWTH CURVE OF BROILER

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ABSTRACT
An experiment was conducted to investigate the effect of adding different percentages of cumin oil in diet (0% (control), 15%, 30% and 45%) on weekly and final body weight of Ross 308 broiler. Profile analysis was applied to detect the parallelism between growth curves of all groups, whereas nonlinear regression and linear regression were used to fit growth curves. The groups' profiles were found not parallel in terms of cumulative weekly body weight. Two ways analysis of variance with interaction (ANOVA) was performed and t-test was used to identify the differences between studied traits. Results revealed that adding cumin oil to diet has increased significantly ($P < 0.05$) the weekly and final weight in treated groups as compared with control. In order to describe the growth curve, four statistical methods were used: simple linear regression and Gompertz, Verhulst, and Weighted Least Square (WLS) nonlinear regression. Results obtained that WLS function was more powerful for fitting the data as compared with other functions. As there are significant differences in weekly and final body weight in addition to that the growth curves were no parallel, the adding of cumin oil (45%) to diet of broiler may play an important role in profitability by increasing the final body weight.

KEY WORDS: growth curve, nonlinear regression, cumin, broiler *etc.*

INTRODUCTION

It was well known that using antibiotics as promoters had a substantial role in poultry industry as the growth rate of broiler chickens has been improved greatly. The World Health Organization (WHO) has recently identified antibiotic resistance as a major problem for public health. For this reason, several studies were conducted to looking for and evaluate suitable alternatives for antibiotics. Medicinal plants and their products including plant extracts or essential oils are adopted as suitable candidates for use in broiler diets due to their beneficial effects as phytogenic feed additives (Bolukbasi & Erha, 2007; Soltan *et al*., 2008 and Dalkiliç *et al*., 2009). Such compounds influence poultry productivity and health mainly by stabilization of normal gut microflora, prevention of pathogens colonization (Tekeli *et al*., 2006) and digestive enzymes production and activities improvement (Lee *et al*., 2004). Many studies have been conducted to investigate the effect of using herbal plants as feed additives in broiler diets (Halle et al., 1999; Osman, 2002; Abbas and Ahmed, 2010; AL-Kassie *et al*., 2011; Khan *et al*., 2012). Herbs contain some complicated mixtures of organic chemicals that may vary depending upon many factors related to the growth, production, and processing of the herbal product (Amal *et al*., 2013). Though herbs with antimicrobial properties are reported, their using in broiler diets has not been studied extensively. However, little or no work has been done on the effects of plant extracts on poultry growth curve in Iraq.

Growth curve models provide a set of parameters that are using to describe growth pattern over time, and to estimate the expected weight of animals at a specific age (Tzeng and Becker, 1981; Yakupoglu and Atil, 2001). In addition, the parameters obtained from growth curve functions are highly heritable and have been used in selection studies (Merrit, 1974; Mignon-Grasteau *et al*., 2000).There is a set of growth curve functions used to determine age-weight relationship of poultry. The functions have different properties and different mathematical limitations. The present study was conducted to determine the effect of adding different levels of cumin oil in broiler diets as feed additives on the shape of growth curve in addition to use linear and some non-linear functions to fit the growth curve.

MATERIALS & METHODS

An experiment was carried out at poultry farm in College of Veterinary Medicine /University of Baghdad. A total of 200day old (Ross 308) chicks were used. The experiment was lasted long for 35 days. Chicks were randomly divided into four groups with 50 chicks each and located as follows: (T0) chicks group freely access feed *ad libitum* as a control, the remaining treatments (T1, T2, and T3) chicks were fed diet with adding cumin oil at 15, 30, and 45%. Nipple drinker and round feeder were used to satisfy the requirements of chickens. Birds were fed with starter diet between 0-3 weeks and with growth diet at 4^{th} and 5^{th}weeks, Chemical composition of the basal diet is presented in Table 1. It is formulated to meet nutrient requirement of broiler chickens. Barn conditions (temperature, humidity) were kept similar for each group.

TABLE 1: Chemical composition of the basal diet in different periods of the experiment

Ingredients%	Starter	Finisher
	1-21 days	22-35 days
Yellow corn	51.0	53.3
Wheat	13.8	15.0
Soybean oil	1.0	2.5
Premix*	2.5	2.5
Methionine	0.1	0.1
Salt	0.3	0.3
Lysine	0.1	0.1
Di-calcium phosphate	1.2	1.2
Total	100	100
Calculated chemical analysis		
ME(Kcal/kg)	3000	3086
Crude protein	21.30	19.50
Calcium	0.69	0.52
Available phosphate	0.74	0.69
Methionine	0.33	0.31
Lysine	1.19	1.08

∗Premix (2.5%) Provided the following (Per Kg of complete diets). Vit A. 367500 IU,133500 IU Vit. D3, 1920 mg Vit.E, 84.42 Vit. K3, 50 mg Vit. B1, 150 mg Vit. B2, 500 mg Vit. B3, 177.5 mg Vit. B6, 0.8 mg Vit. B12, 600 mg Vit. PP, 24.5 mg folic acid, 27 mg biotin, 5767.5 mg choline, 2667 mg Fe, 333.75 mg Cu, 3334.06 mg Mn , 203 mg Co , 2334.38 mg Zn , 100.75 mg Ca , 10 mg Se, 65446.46 mg Ph, 36667.5 mg DLMithionine, 200.02mg, Ethoxyquin,50mg, Flavophospholipol, 30g Fish meal, 1800g wheat bran

Statistical Analysis

Profile analysis and four functions 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 body weight of Ross 308 broiler raised under four different levels of feed additive. This allowed for the assignment of a level of statistical significant differences and the shapes of the centroids of four groups. Profile analysis is a method of comparison of groups that are experimental units to 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 special case of MANOVA. The basic of profile analysis is a sequence comparison method for finding and aligning distantly related sequences.

There are 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).

To fitting growth curves, three nonlinear functions (Gompertz, Verhulst and WLS) and one linear function were used to investigate the effect of supplementation of different levels of cumin oil in diet on the shapes of growth curves of broiler.

Functions were defined as follows:

Gompertz growth function:

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

Verhulst growth function:

$W = A / (1 + k * \exp (-b * t))$

Weighted least square growth function:

$W = A/ (1+\exp (-b-k*t))$

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

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

RESULTS & DISCUSSION

Test of parallel profiles obtained that the null hypothesis of parallel profiles is rejected as F= 13.24, Wilk's Lambda = 0.038 with p-value = 0.0001(Figure 1).

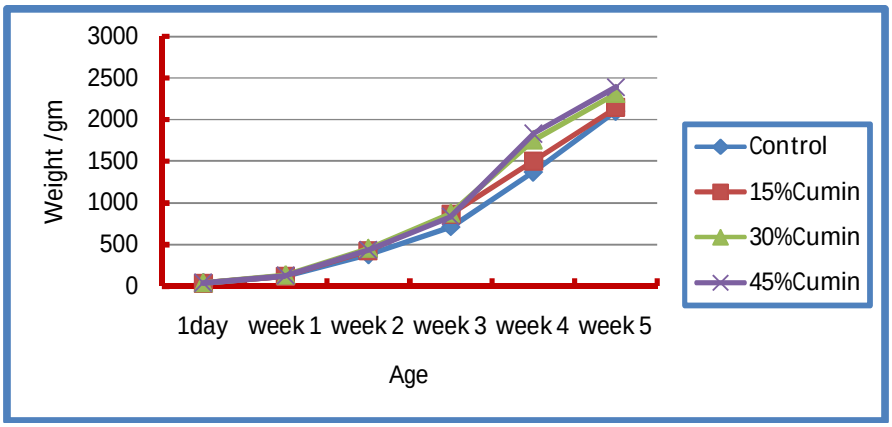

FIGURE 1: Profiles of weekly body weight of all groups

Two ways analysis of variance with interaction (ANOVA) was conducted to test the differences between means of treatments within each period. Results revealed that the differences between treatments were significant ($P < 0.05$). As shown in table (2) the chicks in group 3 and 4 have higher body weight at first week as compared with control. The dominance in body weight of group 3 and 4 was continued through progress age till the fourth week as in fifth week, the final body weight of group 4 only has been differed significantly ($P < 0.05$) compared with control. These results are in agreement with those results reported by several researches who confirmed that the final body weight increased as a result of adding herbal plants to broiler diet (William & Losa, 2001; AL-Kassie *et al.*, 2011; Khan *et al.*, 2012).

TABLE 2: Means of weekly and final body weight of groups (control, T1, T2, and T3)

Group	1 day	1 weeks	2 weeks	3 weeks	4 weeks	5 weeks
Control	$^{E}38.50\pm0.61^{a}$	$^{E}121.10\pm7.69^{b}$	$^{D}378.50\pm24.03^{b}$	$^{C}712.90\pm25.77^{b}$	$^{B}1370.10\pm56.51^{b}$	$^{A}2102.00\pm72.36^{b}$
15% cumin	$^{E}38.20\pm0.07^{a}$	$^{E}123.90\pm6.29^{ab}$	$^{D}429.50\pm21.81^{a}$	$^{C}866.80\pm41.00^{a}$	$^{B}1503.30\pm0.01^{b}$	$^{A}2149.40\pm102.20^{b}$
30% cumin	$^{E}39.60\pm0.49^{a}$	$^{E}135.40\pm4.44^{a}$	$^{D}454.00\pm14.62^{a}$	$^{C}876.10\pm22.40^{a}$	$^{B}1759.70\pm51.47^{a}$	$^{A}2315.90\pm59.58^{ab}$
45% cumin	$^{E}39.30\pm0.55^{a}$	$^{E}128.00\pm3.05^{a}$	$^{D}436.40\pm11.43^{a}$	$^{C}833.60\pm22.43^{a}$	$^{B}1835.30\pm43.07^{a}$	$^{A}2390.90\pm68.36^{a}$

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

Concerning the fitting growth curves, three nonlinear functions and one linear function were used. In order to determine goodness of fit for growth curves, the values of mean square error (MSE) were taken in our consideration. The values of MSE of WLS function are 637.11, 1005.53, 926.40 and 802.68 for groups: control, 1, 2 and 3respectively (Table 3, 4, 5, 6) which represent the lowest values as compared to those values of other functions. Results indicated that WLS function was the best function for describing the shape of growth curves for all treatments; on the other hand the corresponding values of MSE for linear function were58463.46, 56293.73, 66808.35, and 82387.68 respectively which mean that linear regression was the worst function to fit growth curves as compared with nonlinear functions.

TABLE 3: Parameter estimates and growth characteristics of broiler based on Gompertz, Verhulst and WLS functions and linear regression in control group

Parameter	Gompertz	Verhulst	WLS
	Mean±SE	Mean±SE	Mean±SE
A	8872.96±3863.08	3253.86±396.91	2874.82±205.11
b	0.03±0.008	0.13±0.01	-4.17±0.10
K	44.39±9.71	54.80±8.15	0.14±0.007
MSE	15874.22	15952.41	637.11
Linear	$\hat{Y}$=-278.12+60.30x		
MSE	58463.46		

TABLE 4: Parameter estimates and growth characteristics of broiler based on Gompertz, Verhulst and WLS functions and linear regression in 15% cumin oil

Parameter	Gompertz	Verhulst	WLS
	Mean±SE	Mean±SE	Mean±SE
A	4836.03±1285.00	2825.30±276.22	2555.20±152.39
b	0.05±0.01	0.14±0.01	-4.05±0.13
K	31.02±5.14	44.38±9.45	0.16±0.009
MSE	26578.93	27179.98	1005.53
Linear	$\hat{Y}$ =-267.08+55.42x		
MSE	56293.73		

TABLE 5: Parameter estimates and growth characteristics of broiler based on Gompertz, Verhulst and WLS functions and linear regression in 30% cumin oil

Parameter	Gompertz	Verhulst	WLS
	Mean±SE	Mean±SE	Mean±SE
A	3925.41±650.36	2676.22±156.10	2681.24±132.91
b	0.06±0.01	0.17±0.01	-4.22±0.13
K	26.00±2.70	68.26±17.93	0.17±0.008
MSE	24683.74	25008.37	926.40
Linear	$\hat{Y}$ =-301.92+68.48x		
MSE	66808.35		

TABLE 6: Parameter estimates and growth characteristics of broiler based on Gompertz, Verhulst and WLS functions and linear regression in 45% cumin oil

Parameter	Gompertz	Verhulst	WLS
	Mean±SE	Mean±SE	Mean±SE
A	4175.40±625.40	2809.83±131.94	2926.63±140.13
b	0.07±0.01	0.18±0.01	-4.44±0.13
K	26.54±2.31	106.12±27.64	0.17±0.008
MSE	24283.50	19711.90	802.68
Linear	$\hat{Y}$ =-351.12+72.63x		
MSE	82387.68		

According to MSE values it's obvious that Gompertz function has lower values as compared with Verhulst function and linear regression. In other words it was more appropriate for describing growth carve in control, group 1 and 2 whereas the situation was in contrast for group 3 as Verhulst function has lower MSE value. These results are in accordance with the results of no parallelism in growth curves, that was noticed previously which means that the power of functions -except WLS- was not same when the curves have different shapes also these results confirm other results reported by Narinc *et al*. (2010) who found that Gompertz function was more fit for broiler growth curve in female and male as compared with Bertalanffy and logistic functions.

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