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Ferula eleaochytris Powder Effect in Layer Diet on Feed Intake and Some Egg Parameters Using a Multivariate Analysis Method for Repeated Measures

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Abstract

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A study was carried out to test the effect of ***Ferula eleaochytris*** *root powder (FE) on feed intake and some egg parameters of laying hens by using the multivariate test for repeated measures. FE treatment affected fresh egg shell weight (P<0.05), dry egg shell weight (P<0.01) and consequently lowered shell thickness (P<0.01) even though FE2 treatment increased feed intake (P<0.05). Egg weight, egg albumen weight, egg yolk weight and egg production were not affected by FE treatment (P>0.05). FE appears to have a negative effect on calcium absorption from gastro-intestinal tract.*

Key words: *Ferula eleaochytris*, poultry, repeated measures, multivariate analysis, egg parameters.

Introduction

Like other ferula varieties, *Ferula eleaochytris* from *Umbelliferae* family is one of local traditional medicinal and aromatic plants in Hatay Province of Turkey (Ayanoglu *et al.*, 1999). The studies regarding ferula varieties are mostly based on their chemical constitutes rather than their physiological effects. Consequently, there has been a lack of information about ferula varieties with respect to their effects on animal production. Sahin *et al.* (2004) fed *Ferula eleaochytris* to broiler chicks and found increased carcass and breast weights of chicks. However, there was no information regarding the effect of ferula extracts on egg production of laying hens.

Repeated measurements, as the name suggests, are observations of the same characteristic, which are made several times on the same subject(s). Different methods are used for the analysis of repeated measures. Some of them are univariate variance

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analysis technique of repeated measures, non-parametric and multivariate analysis techniques.

In many biological experiments, due to large tendency of variance based on the mean largeness, the variance-covariance matrix from treatment groups is usually not homogeneous. In such situations, using the univariate analysis techniques may cause faulty results. For this reason, using multivariate analysis techniques in analysis of repeated measurements are more useful when the assumptions validity is dubious.

In this study, the effect of FE powder in layer diet on feed intake and some egg parameters by using a multivariate test for repeated measures with two factors one of them containing repeated measures was explained.

Materials and Methods

Twenty-four Isa Brown brown egg-type hens, aged 40 weeks, were fed on a layer diet containing 11 MJ ME, 45 g oil, 160 g CP, 60 g fibre and 150 g ash per kg fresh matter food with an illumination of 14 h light:10h dark cycle. Hens weighing similarly were randomly assigned to one of 4 FE doses. The FE treatments were control diet (C), 10 g FE powder per kg diet (FE1), 20 g FE powder (FE2) and 40 g FE powder (FE3). Feed was offered to birds daily *ad lib* but recorded (cumulative) weekly throughout this study. Hen-day egg production as percent was determined weekly.

The sample eggs from FE treatment (11 eggs for each treatment per two-week) were broken to determine the weights of albumen, yolk and shell + membrane by using a domestic egg separator. The amount of albumen was obtained by the difference between yolk + shell weights from the whole egg weight.

The data regarding egg weight (g), albumen weight (g), egg yolk weight (g), dry egg shell weight (g), shell thickness (mm), feed intake (g), egg production (%) and fresh egg shell weight (g) were measured. The assumptions for univariate tests of repeated measures were tested and then both the univariate and multivariate tests were applied to data for comparing the results. The General Linear Model (GLM) procedures of SPSS package for repeated measures were used (SPSS, 1999). Duncan Multiple Range test was used to separate the means among the treatment groups.

The mathematical model for the analysis of experimental data was :

$$y_{ijk} = \mu + \alpha_i + \gamma_{(i)k} + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{(i)jk}$$

$$i = 1,2,3...n, j = 1,2,3,..., p , k = 1,2,3,..., t \text{ (n.q)}$$

where μ is overall mean, α_i, is the effect of i^{th} level of BSF (FE doses), β_j is the effect of j^{th} level of WSF (week), $\alpha\beta_{ij}$ is interaction effect of i^{th} level of BSF (FE doses) and j^{th} level of WSF (week), $\gamma_{(i)k}$ is the effect of k^{th} experimental unit in i^{th} level of the BSF (FE doses) (Error 1) and ε_{ij} is error term (Error 2) (Timm, 1980; Gill, 1981). For testing the BSF, WSF and interaction effects U - statistics were used (Gill, 1981).

Results and Discussion

The variance-covariance structure was found homogenous in each level of FE doses for fresh egg shell weight for hen as $q = 20.50 < \chi^2_{0.05, 30} = 43.73$. This assumption was tested and validated for all properties in this study. But the pooled variance-covariance structure from all treatment groups was not homogenous as $q = 15.874 > \chi^2_{0.05, 8} = 15.507$.

The univariate tests were made for all characteristics. But, because of not validation of the assumption, that pooled variance-covariance structure from all feeding systems is homogenous, for the data regarding fresh egg shell weight measurements for hen, the multivariate test method of repeated measures was applied to fresh egg shell weight data to test the effects of the FE doses, week and the FE treatment x week

Table 1: Effects of FE on feed intake and some egg parameters

Egg parameters	Control (0 g FE kg^{-1})	FE 1 (10 g FE kg^{-1})	FE 2 (20 g FE kg^{-1})	FE 3 (40 g FE kg^{-1})
Egg weight (g)	55.14±0.88	54.40±0.62	55.07±0.62	55.25±0.97
Egg albumen weight (g)	33.11±0.94	32.19±0.57	32.98±0.65	33.72±0.77
Egg yolk weight (g)	14.75±0.45	15.61±0.34	14.82±0.36	15.13±0.41
Dry shell weight (g)	6.08±0.16^{a}	5.34±0.20^{b}	5.56±0.19^{b}	5.17±0.14^{b}
Shell thickness (μm)	342±9^{a}	319±13^{ab}	288±11^{bc}	272±12^{c}
Feed intake (g)	102±0.3^{a}	106±1.5^{b}	114±1.2^{b}	102±1.5^{a}
Egg production (%)	87.5±4.6	86.3±3.7	91.7±2.7	81.0±5.3
Fresh egg shell wt.(g)	7.27±0.18	6.59±0.25	6.85±0.21	6.51±0.17

^{a,b,c}Means followed by different superscripts differ (P<0.05).

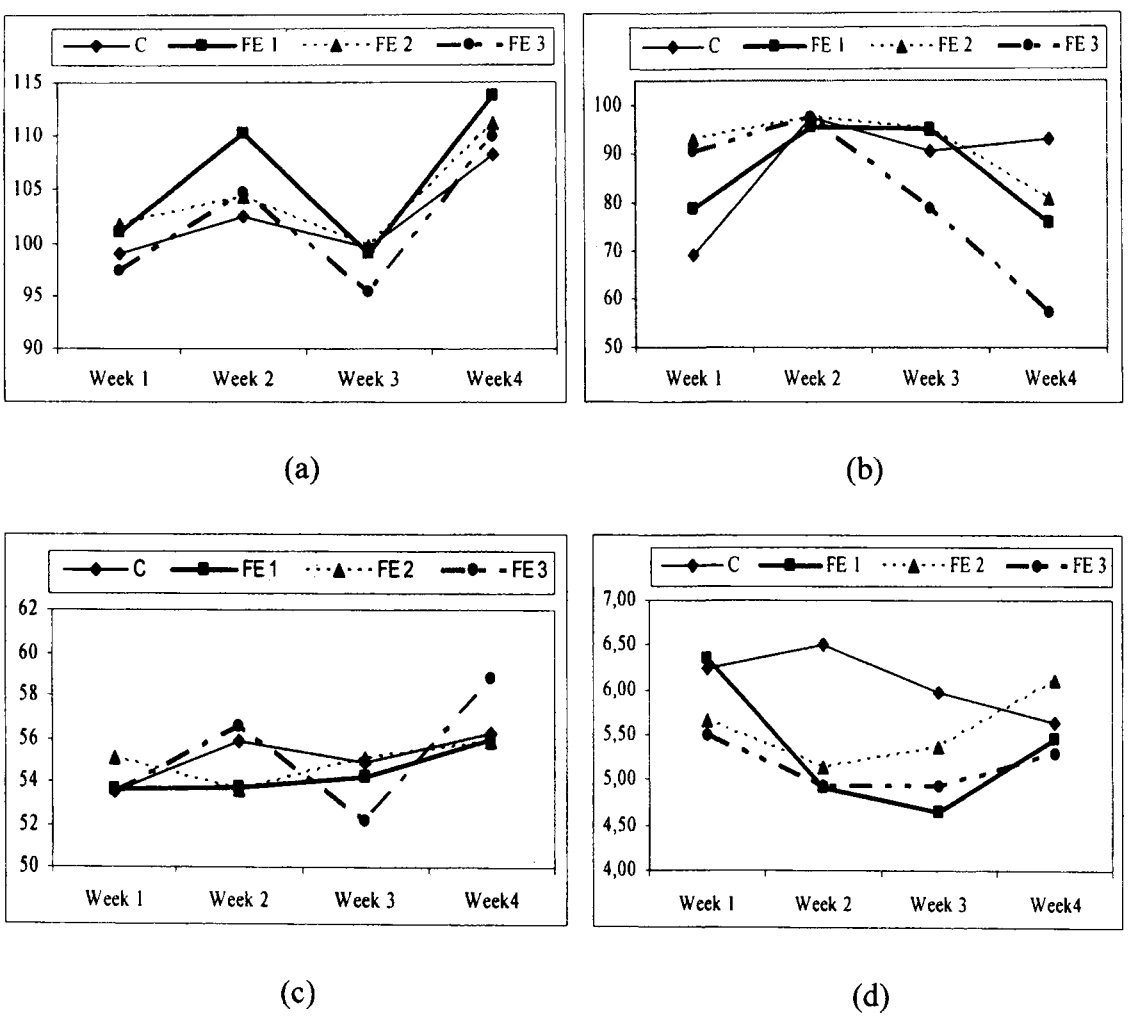

Fig. 1. The variation of the feeding systems averages *versus* the weeks for (a) Feed intake (g/hen), (b) Egg production (hen-day production), (c) Egg weight (g/hen), (d) Dry egg shell weight (g/hen).

Table 2
Univariate test results of the FE effects on feed intake and some egg parameters

Source of variation	DF	Egg weight MS	Egg weight Sig.	Egg albumen weight MS	Egg albumen weight Sig.	Egg yolk weight MS	Egg yolk weight Sig.	Dry egg shell weight MS	Dry egg shell weight Sig.	Shell thickness MS	Shell thickness Sig.	Feed intake MS	Feed intake Sig.	Egg production MS	Egg production Sig.	Fresh egg shell wt. MS	Fresh egg shell wt. Sig.
Between subject																	
Treatment	3	3.57	0.905	10.03	0.613	3.67	0.418	3.82	0.007**	21081.9	0.006**	87.18	0.038*	310.0	0.730	2.78	0.033*
Error-1	20	19.22		16.29		3.71		0.71		3772.8		25.75		711.8		0.78	
Within subject																	
Week	3	44.35	0.022*	41.34	0.023*	16.45	0.004**	2.25	0.023*	40132.1	0.000**	762.0	0.000**	1511.3	0.000**	6.46	0.000**
Treatment x-week	9	11.15	0.561	7.63	0.766	2.12	0.767	1.14	0.101	1667.4	0.086	17.00	0.603	384.01	0.028*	1.43	0.193
Error-2	60	12.89		12.09		3.37		0.66		923.4		24.00		168.51		0.80	

*Significant at $P<0.05$, **Significant at $P<0.01$.

interaction on fresh egg shell weight for hen as follows:

Effect of FE doses

U statistics for testing of FE effect was computed as U = 0.653 and the critical values concerning U statistics as $U_{0,05,4,9,57} = 0.4169$ and $U_{0,01,4,9,57} = 0.3663$. Due to 0.653 > 0.4169, there were no significant differences among the FE doses with respect to their effect on fresh egg shell weight. Otherwise, the univariate test results of this parameter showed that there were significant differences among the FE doses on fresh egg shell weight for hen (Table 2).

Effect of the weeks

U statistics for testing of the weeks effect was computed as U = 0.4040 and the critical values concerning U statistics as $U_{0,05,4,3,57} = 0.6825$ and $U_{0,01,4,3,57} = 0.6213$. Due to 0.4040 < 0.6213, there were significant differences among the weeks on fresh egg shell weight for hen. The similar inference was obtained from univariate test of that characteristic (Table 2).

Effect of FE treatment x week interaction

U statistics for testing of FE treatment x week interaction effect was computed as U = 0.641587 and the critical values concerning U statistics as $U_{0,05,4,9,57} = 0.4169$ and $U_{0,01,4,9,57} = 0.3663$. Due to 0.641587 > 0.4169, FE treatment x week interaction was not significant on fresh egg shell weight for hen.

The data regarding the effect of FE on egg weight, albumen weight, egg yolk weight, dry egg shell weight, shell thickness, feed intake, egg production and fresh egg shell weight were analyzed by using two-way Repeated Measurement design. Results showed that week effect was found to be significant on feed intake, egg production, egg yolk weight, fresh egg shell weight, shell thickness ($P<0.01$), egg weight, egg albumen weight, dry egg shell weight ($P<0.05$) and the FE treatment was found to be significant on feed intake, fresh egg shell weight ($P<0.05$),

dry egg shell weight and shell thickness ($P<0.01$), and FE treatment x week interaction effect was not significant for all egg properties ($P>0.05$) except egg production ($P<0.05$). The means of significance by recorded parameters were compared by using Duncan multiple range test and the results are presented in Table 1. In addition, the variation of the FE doses means *versus* the weeks for feed intake (g/hen), egg production (hen-day production), egg weight (g/hen) and dry shell weight (g/hen) are plotted and given in Fig. 1.

FE powder did not affect egg production, egg weight, egg albumen and yolk weights. The lowest and middle doses of FE increased feed intake significantly. On the other hand, FE had negative impact on shell thickness assuming that FE might be diminishing calcium absorption from digestive system of hen. The negative effects of FE on shell thickness show that FE is not preferable for enhancing egg production and egg quality parameters (Table 1, Fig. 1). FE needs to be studied further by considering the calcium content of diet to clarify whether it has estrogenic effect or not.

It can be concluded that multivariate analysis of variance of repeated measures method will replace the standard univariate repeated measures techniques that occur in practice when univariate repeated measures model assumptions are not satisfied.

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एस. साहिन्लर, ए. साहिन, ओ. गोर्गुलु। पुनरावृत मापों के लिए बहुचर विश्लेषण के उपयोग से अंडजों के आहार में फेरुला इलियोकाइट्रीस के चूर्ण का आहार भक्षण और अंडों के कुछ प्राचालों पर प्रभाव।

पुनरावृत मापों के लिए बहुचर विश्लेषण विधि के उपयोग से अंडज मुर्गियों के आहार में फेरुला इलियोकाइट्रीस (फेइ) की जड़ का चूर्ण मिश्रित करने का आहार भक्षण और अंडों के कुछ प्राचालों पर प्रभाव परीक्षण हेतु एक अध्ययन किया गया। फेइ उपचार से ताजा डिम्ब कवच का भार, शुष्क डिम्ब कवच भार के प्रभावित होने के परिणाम से फेइ 2 उपचार में आहार भक्षण बढ़ने पर भी डिम्ब कवच मोटाई में कमी हुई। फेइ उपचार से डिम्ब भार, डिम्ब एल्ब्युमिन भार, डिम्ब योक भार और डिम्ब उत्पादन में कोई परिवर्तन नहीं था। ऐसा प्रतीत होता है कि आहार में फेइ मिश्रित करने से आहार तंत्र से कैल्सियम का अवशोषण घटता है।