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Dietary Effect Of Methionine And Lysine On Growth Performance Of Ostrich Chicks In Bangladesh

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Abstract
Twenty-four Ostrich chicks (Ostruthiocamelus) aged one week were brought for research from South Africa to the Poultry Research Center, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh and reared under semi intensive management system. Theformulated ration was supplied along with ad-libitumroughagesto the control group (T_0). While treatment groups T_1, T_2 and T_3 were added methionine 0.3, 0.4, 0.5 and lysine 0.8, 1.0, 1.2 percent in feedrespectively. Fresh drinking water was suppliedad-libitum to the ostrich chicks. Different physical parameters were measured during the study period and treatment group 3 showed better results than others treatment groups including control group. The data state that initial body weight (g), feed intake (g/day), water consumption (ml/w) and feed conversion ratio (FCR) were found6480±151, 47896.84±1633, 105190±1040 and 2.05±0.053, respectively. Ostrich chicks are grown very fast with in first 4 months of age, but during this time mortality rate 12% counted as of end the experiment. The body measurements at different parameters of ostrich were highly significant (P< 0.05). High positive correlations between live weight and other parameters were measured (neck diameter and length, shank diameter and length, wing and feather length, body length, heart girth and bird height) in treatment group 3.

Key words: *Ostrich chicks, feeding practices, BLRI, FCR, nutritional requirements*

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I. INTRODUCTION

Ostrich meat has characterized as the primary product due to low-fat and low-cholesterol (Ctiliers and Huchzermeyer, 1998). Ostrich farming has spread worldwide and fully established in South Africa(Ciliers and Huchzermeyer, 1998; Tully and Shane 1996). Byproducts derived from ostrich production like leather, feather and oil also have a worldwide market. The experiments conducted on ostrich, so far have been very poor about literature and available evidences mainly focused on nutritional requirements of ostrich (Ullrey and Allen, 1996). Methionine and lysine are the limiting amino acids of the 10 indispensable amino acids that cannot be synthesized by poultry in adequate amounts to support optimum performance(Corzo et al. 2007; Rehman et al. 2019). Traditionally, methionine and lysine are considered to be the 1st and 2nd limiting amino acid, followed by in commercial poultry diets based on maize/wheat and soybean meal. Methionine and lysine play an important role in the animal body, being associated with structural proteins in the body and feathers. Besides, its important role on protein synthesis, it is a source of methyl groups required for all biological methylation reactions. Nutrient requirements have been changing with changes in growth rate and body weight of birds. Therefore, methionine and lysine requirements must be adjusted to increasing body weight of birds. Different nutrients requirement of ostrich stated in "Nutrition guidelines for ostriches" from Ames, Iowa; Pm-1696 January 1997; Iowa State University, USA mentioned that Lysine levels 0.90% and 0.85%, and methionine levels 0.37% in both of age, were fed from 0 to 9 weeks and 9 to 42 weeks of age in ostrich respectively. Du Preez***et al.*** (1990) described the requirements of Oudtshoorn males were subsequently calculated and these results will be presented as an illustration of hypothetical requirements for lysine and sulphur-containing amino acids (SAA) during the normal development under non-limiting conditions from hatching to maturity.It is also, stated by (Ciliers and Huchzermeyer 1998), the knowledge of various nutritional aspects of ostrich were not well defined. Ostrich indifferent regions showed different development of bodyweight and high concentrate feed intake resulted to rapidgrowth during age of four months (More, 1996). The aim of this study was to evaluate some characteristics of ostrich chicks in Bangladesh, particularly the husbandry and the feeding practices.Total value of world ostrich production in 2018 was nearly $12 billion.

Table 1: World ostrich production trend from 2000 t0 2019

Overseas countries	2018/2019	2010	2000	Overseas countries	2018/2019	2010	2000
China	500000*	500000*	250000*	Ukraine	50000****	1500*	0
Brazil	250000*	450000*	0	Romania	10000	1000	0
South Africa	130000**	250000	300000	Poland	3000	5000	0
Pakistan	100000*	0	0	Germany	2500	1750	1000
Iran	40000*	0	0	Portugal	2000	2000	2000
Arabian Emirates	25000*	0	0	Hungary	1500	1000	0
Botswana	15000	0	0	France	1500	1500	500
New Zealand	15000	15000	10000	Austria	1000	1000	500
Australia	15000***	15000***	30000	Bulgaria	1000	0	0
Israel	0	1000	25000	Italy	1000	2000	5000
Namibia	0	2000	25000	Spain	1000	1500	7000
Zimbabwe	0	5000	55000	TOTAL	**1164500**	**1256250**	**711000**

Source: *Christoph Kistner Center for Ostrich Breeding and Research/ Mhou Farm 76761 Rülzheim/ Germany)*

II. MATERIALS AND MATHOD

Source of birds: Twenty-four ostrich chicks aged one week were brought from South Africa, randomly divided into four groups, identified by neck tag. The initial weight of each ostrich was taken; daily feed, roughages and water intake were recorded.

Housing: This experiment was conducted at the Poultry Research Center, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh. The birds were provided individual group pens for night shelter in four pens and eachwasheight2.5 m, length and width 3 m with 3 x 1.5 m door, where, the lower 1/3 part was fenced by plane sheet and upper 2/3 part and inside partitions were made with wire net. Each pen was open with adjacent 24.5 x 10 m free range area for running, dancing and wildly movement. The floor of pens was covered with dry sand. Each pen was supplied linear 1.5 x 0.5 x 0.75 m^3size one feeder and one drinker, which was made up with steel sheet andsituated on iron frame.

Feeding: The concentrate mash feed were supplied to the chicks and its chemical composition is presented in (Table 1). With a rotation water spinach (*Ipomoea aquatica*), cabbage (*Brassica oleracea*), and spinach (*Spinacia oleracea*) were provided two times (9.00am and 3.00pm) a day. Minerals, Vitamin B complex and/or Vitamin C were provided one alternate day to the Ostrich chicks. Pieces of stone or grit mixture were always ensuring and broken oyster shell or lime stone used rotationally. *Ad-libitum*drinking water was suppliedto the ostrich chicks.

Table 2: Concentrate rations (%DM) and composition for Ostrich chicks in Bangladesh

	General formula				
Sl. No.	**Ingredients** (Amount kg, % DM)	**T_0**	**T_1**	**T_2**	**T_3**
1	Maize	405	405	405	405
2	Soya DOC 45%	235	235	235	235
3	Soya (Full Fat)	150	150	150	150
4	Wheat Bran	115	115	115	115
5	DDGS(Rice)40%	15	15	15	15
6	Poultry Byproduct Meal	10	10	10	10
7	LSP-Lime Stone Powder	35	35	35	35
8	MCP-Monocalcium phosphate	6	6	6	6
9	Oil - Rice Bran	10	10	10	10
10	Salt	5	3.9	3.6	3.3
11	Soda-Sodium	1.8	1.8	1.8	1.8
12	DL-Methionine	1.5	1.8	1.9	2
13	L-Lysine HCL	2.8	3.6	3.8	4
14	Vitamin Premix	0.5	0.5	0.5	0.5
15	Choline Chloride, 60%	1.5	1.5	1.5	1.5
16	Toxin Binder	2	2	2	2
17	TM-Trace Mineral	0.5	0.5	0.5	0.5
18	Acidifier (Nilsal Dry	1	1	1	1
19	L-Threonine	0.5	0.5	0.5	0.5
20	Mineral Mixture	1	1	1	1

21	Phytase-5000	0.1	0.1	0.1	0.1
22	Lipidin - Poultry	0.5	0.5	0.5	0.5
23	Probiotic	0.15	0.15	0.15	0.15
24	Antioxidant	0.15	0.15	0.15	0.15
	Total:	1000	1000	1000	1000
Sl. No.	**Nutrient Name**				
1	M.E (kcal / kg)	2910.92	2915.54	2916.82	2918.1
2	Crude Protein (%)	23.1053	23.1835	23.2045	23.2255
3	Lysine (%)	1.411	1.4742	1.49	1.5058
4	Methionine (%)	0.4688	0.4982	0.508	0.5178
5	Available Phosphorus	0.4638	0.4638	0.4638	0.4638
6	Calcium (%)	1.7361	1.7361	1.7361	1.7361
7	Threonine (%)	0.8848	0.8848	0.8848	0.8848
8	Moisture (%)	9.5476	9.5477	9.5477	9.5477
9	Fat (%)	7.15	7.15	7.15	7.15
10	Crude Fiber (%)	4.8575	4.8575	4.8575	4.8575
11	T.D.N (%)	78.125	78.125	78.125	78.125

Prevention and treatment: The chicks were vaccinated mainly 2 types of vaccines (BCRDV and RDV) throughout the experimental periods. As a preventive measure the mentioned vaccinations were done carefully and maintaining the cool chain. Vitamin B complex, AD_3E and Calcium injection were orally administered and injected in the thigh muscle.

Experimental design: A total 24 ostrich chicks were used for this study. There were four dietary treatment groups with three replications having two birds in each replication. Formulated concentrate feedand roughages were supplied to all experimental birdsat ad-libitum along with in control group T_0 too. While treatment group T_1, T_2 and T_3 were added methionine 0.3, 0.4, 0.5 and lysine 0.8, 1.0, 1.2 as extra percent respectively [Table-2].

Experimental data collection: The records of total feed and water intake were kept daily and other parameters recorded weekly. Live weight of the chicks were carried out using electronic balance and neck diameter was taken from around its middle, neck length was taken from last cervical vertebrate to posterior end of the atlas, wing length was taken from coracoid to great trochanter of femur, shank diameter was taken from the middle, shank length was taken from hook joint to meta-carpopharngeal joint, heart girth behind wings and bird height was taken from claws to top of the back, were measured with an electronic measuring tape. Collected data were analyzed using one-way analysis of variance (ANOVA) and correlation coefficient using SPSS 22 (USA), respectively.

III. RESULTS AND DISCUSSION

The study revealed that pens with these dimensions are suitable for four treatment groups T_0, T_1, T_2, and T_3 ostrich chicks at three months old, after that age dimensions need to be added and spaces to run around are necessary. Feed and water troughs should be adequate and evenly distributed to avoid injury with sharp edges of metallic one. Chick's behavior like body temperature regulation, scratching the ground and backing feed trough were observed. At third month of age, chicks clustered to flapping their feathers, wings moved forward and lateral, there were pecking and social vices among the birds. Average feed intake, water consumption, daily weight gained and feed conversion ratio (FCR), were estimated and were as depicted in Fig. 1, 9 and 10, respectively. High concentrate feed intake increases growth rate during the age of 2 to 4 months causing leg deformities in the hock joint resulting in death among the birds with mortality rate up to 45% within 4 months old, fowl-pox like lesions was also observed, but disappeared a week later, there were found mole, fowl pox, paralysis and toe fibrosis types diseases in different ages. Table 2, showed the mean and standard deviation for body measurements at different ages of chicks, highly significant difference ($P<0.05$) was found among body measurements and age of chicks. Similarly, there was positive correlation between live weight and (shank diameter and length, nick diameter and length, wing length, body length, heart girth and bird high; Table: 3).

Table 3: Mean and standard error values for different parameters of ostrich chicks (Age 5-12 weeks)

Parameter	**T_0**	**T_1**	**T_2**	**T_3**
Initial Body weight(g/b)	6350±149	6320±134	6430±154	6480±151
Final Body weight (g)	25407.86±1411.64	26871.91±1698.61	27839.29±1847.22	28867.94±2021.58
Total Feed intake (g/b)	59846.96±2929	59579.55±1907	50988.75±1749	45896.84±1633
FCR	3.14±0.216	2.90±0.094	2.38±0.072	2.05±0.053
Water intake (ml/b)	104480±827	94270±591	96460±882	105190±1040
Shank diameter(cm)	13.60^{ab}±0.43	14.27^{ab}±0.31	14.83^{a}±0.56	15.91^{b}±0.75

Shank length(cm)	34.52±0.83	33.22±1.52	35.37±1.51	35.41±1.89
Toe diameter(cm)	15.07±0.62	14.94±0.83	16.04±0.62	15.32±0.98
Toe length(cm)	12.12±0.49	13.82±0.68	13.48±0.71	13.73±0.88
Neck diameter(cm)	15.93±0.43	15.76±0.33	15.53±0.48	15.37±0.58
Neck length(cm)	57.47^{ab}±1.89	63.33^{ab}±1.92	62.07^{a}±2.42	66.92^{b}±2.79
Wing Length(cm)	42.72±1.58	44.58±1.95	45.69±2.06	46.41±2.43
Feather Length(cm)	26.83±2.35	28.17±2.11	29.47±2.18	31.64±12.11
Body Length(cm)	69.10±2.56	72.77±2.58	74.33±2.84	76.86±2.99
Heart girth(cm)	74.92^{ab}±1.98	77.43^{ab}±2.08	78.74^{a}±2.28	83.50^{b}±2.44
Body height(cm)	85.48^{ab}±3.033	88.97^{ab}±2.95	91.28^{a}±3.43	96.27^{b}±3.41

Values are Mean ±Standard error (SE), Significant values are marked with superscripts (a,b).

Table 4: Correlation coefficient of body weight and body measurements of ostrich chicks

Parameter	Body weight	Shank diameter	Neck length	Wing Length	Feather Length	Body Length	Heart girth	Body height
Body weight	1.000							
Shank diameter	0.949	1.000						
Neck length	0.971*	.996**	1.000					
Wing Length	0.974*	0.873	0.904	1.000				
Feather Length	0.924	0.899	0.905	0.948	1.000			
Body Length	0.984*	0.926	0.946	.990*	.974*	1.000		
Heart girth	0.917	0.932	0.928	0.917	.992**	.960*	1.000	
Body height	0.940	0.923	0.928	.951*	.998**	.981*	.995**	1.000

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Regression statistics of body weight and body measurements of Ostrich chicks

Predictors: (Constant)	R Square	Adjusted R Square	Estimate %	Collinearity Statistics			Residuals Statistics
				Correlations	Tolerance	VIF	Mahalanobis Distance
Shank length and shank diameter	0.914	0.742	74.2	0.308	0.905	1.105	2.172
Toe length and toe diameter	0.86	0.58	58	0.199	0.916	1.041	2.249
Neck length and neck diameter	0.974	0.923	92.3	-0.863	0.97	3.908	1.686
Feather length and wing length	0.949	0.847	84.7	0.948	0.102	9.83	2.189
Heart girth and body length	0.977	0.931	93.1	0.96	0.12	12.71	2.244
FCR and body height	0.998	0.995	99.5	-0.929	0.9	7.32	2.245
Weekly feed and water Intake	0.98	0.94	94	-0.54	0.709	1.411	2.239

RSquare: The coefficient of determination (Proportion of variation in the dependable and predictable independent variable), VIF: Variance Inflation Factor

Multiple regression was used to assess the ability of two control measures (a. Shank length and Shank diameter, b. Toe length and Toe diameter, c. Neck length and Neck diameter, d. Feather length and wing length, e. Heart girth and body length, f. Feed Conversion Ratio (FCR) and body height, g. Weekly water intake and feed intake scales) to predict levels of growth (Body weight growth scale).Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multi co-linearity and homoscedasticity. First, boxplots indicated that each variable in the regression was normally distributed, and co-linear correlations 0.308, 0.199, -0.863, 0.948, 0.96, -0.929 and -0.54 accordingly where d and e were highly co-linear (Table. 4). Second, an inspection of the normal probability plot of standardized residuals as well as the scatterplot of standardized residuals against standardized predicted values indicated that the assumptions of normality, linearity and homoscedasticity of residuals were met.Third, Mahalanobis distance did not exceed in all cases the critical $\chi 2$ for df=2 (at α =.001) of 13.82 (Table. 4) indicating that multivariate outliers were not of concern. Fourth, Tolerance and VIF values of multi co-linear statistics were not less than 0.01 and not higher than 10.00 but parameter e violets the linearity (Table. 4). Relatively high tolerances for both predictors in all cases in the regression model indicated that multi co-linearity would not interfere with our ability to interpret the outcome of the regression model.

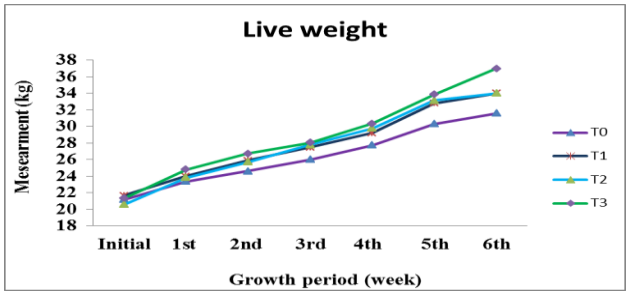

Figure 1. Live weight of experimental birds

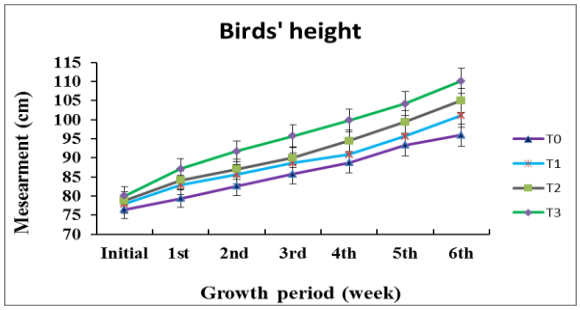

Figure 2. Height of the experimental birds

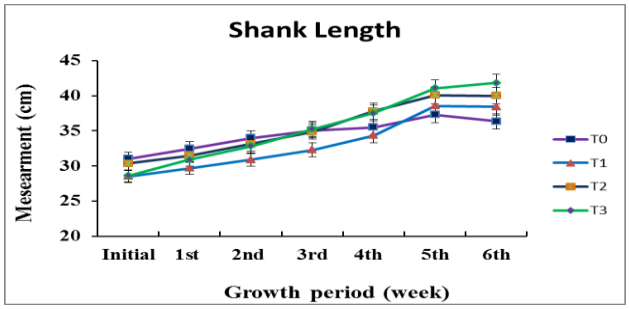

Figure 3. Shank length of the experimental birds

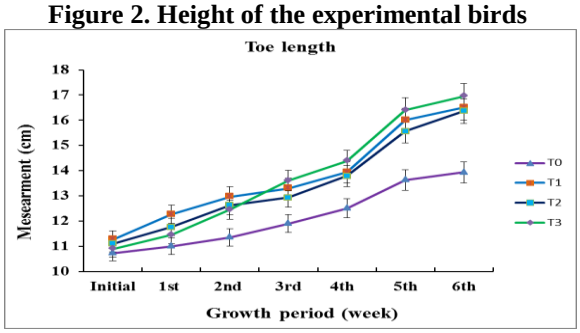

Figure 4. Toe length of the experimental birds

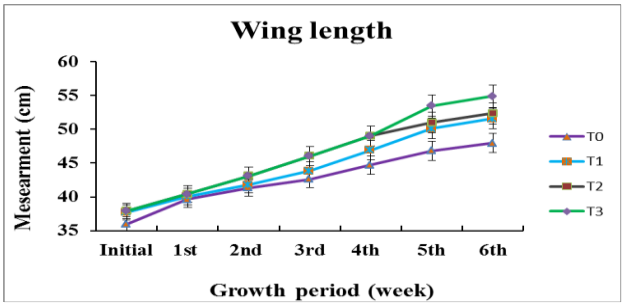

Figure 5. Wing length of the experimental birds

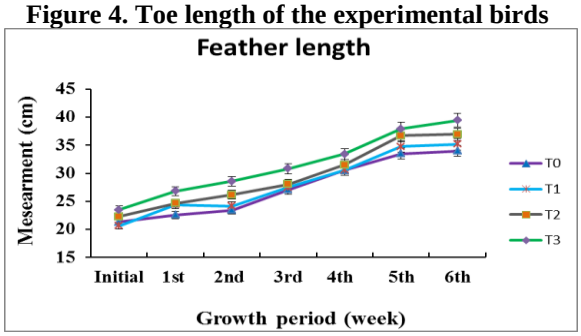

Figure 6. Feather length of the experimental birds

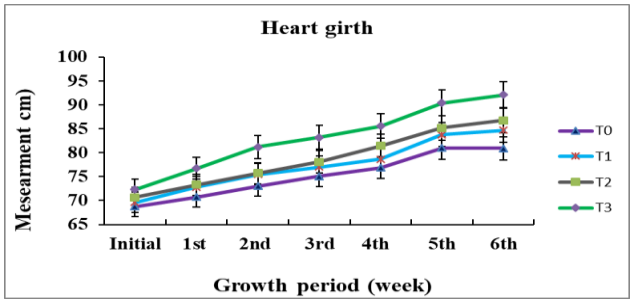

Figure 7. Heart girth of the experimental birds

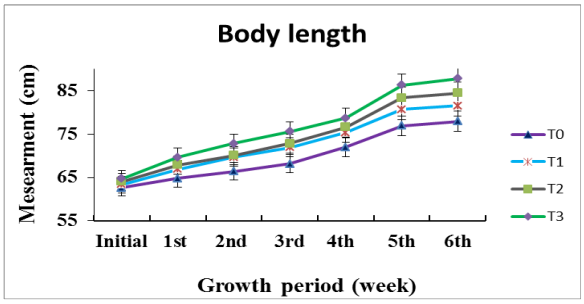

Figure 8. Body length of the experimental birds

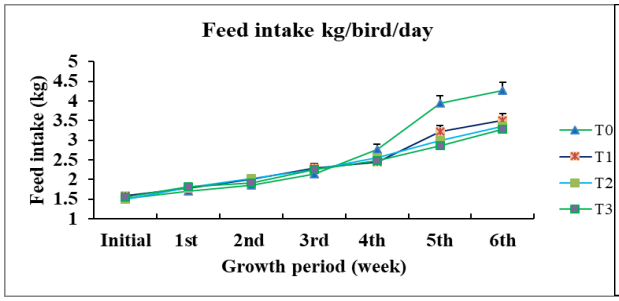

Figure 9. Feed Intake of the experimental birds

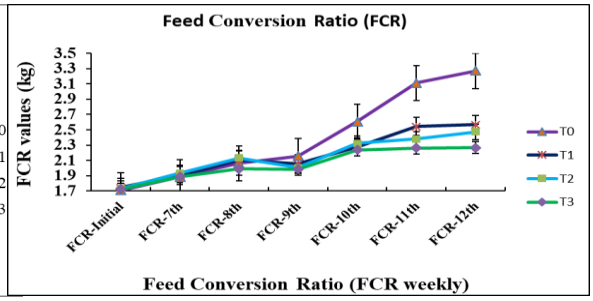

Figure 10. Feed conversion ratio of experimental period

In combinations of the variability in body weight for, a) Shank length and Shank diameter74.2%, R^2= 0.91, adjusted R^2= 0.74, with the shank length scale recording a higher beta value (beta = 0.911, p < .005) than

the shank diameter scale (beta = 0.122, p < .005).b.) Toe length and toe diameter58%,R^2 =0.86, adjusted R^2 = 0.58,with the toe length scale recording a higher beta value (beta = 0.881, p < .005) than the toe diameter scale (beta = 0.163, p < .005). c.) Neck length and neck diameter92.3%,R^2 =0.97, adjusted R^2 =0.92, with theneck length scale recording a higher beta value (beta = 0.672, p < .005) than the neck diameter scale (beta = 0.347, p < .005). d.)Wing length and feather length84.7%, R^2 =0.94, adjusted R^2 = 0.84,with the winglength scale recording a higher beta value (beta = 0.965, p < .005) than the feather length scale (beta = 0.009, p < .005). e.)Body length and heart girth 93.1%, R^2 =0.97, adjusted R^2 = 0.93, with the body length scale recording a higher beta value (beta = 1.315, p < .005) than the heart girth scale (beta = 0.345 p < .005). f.) FCR and body height99.5%,R^2 =0.99, adjusted R^2 = 0.95, with the FCR scale recording a higher beta value (beta = 0.916, p < .005) than the body height scale (beta = 0.089 p < .005).g.) Weekly feed intake and water intake 94%,R^2 =0.98, adjusted R^2 = 0.94,with the weekly feed intake scale recording a higher beta value (beta = 0.924, p < .005) than the weekly water intake scale (beta = 0.113 p < .005). If we could increase the scores of higher control measures by one standard deviation, the lower control measures scores would be likely to drop by 0.42 standard deviation units.

Body measurements were found highly significant among chicks age. The observations of the present study for body measurements (shank diameter and length, nick diameter and length, wing length, body length, heart girth and bird high) is similar to previous studies carried out by Mushi*et al.* (1998) indicated that metatarsal length increased rapidly at weekly rate of 2.50-cm and that body weight was highly correlated with metatarsal length 0.90 and the mean body length reached 134-cm in 4 months.Metal trough can change to plastic to avoid injury and bleeding which resulted in pecking and cannibalism. Chicks behavior observed in this study were same as observed by (Kreibich and Sommer, 1995). They explained that feed conversion ranged from 1.4:1 to 1.6:1 for younger birds at 4 to 6 months old, while for older birds ranging ratio from 4:1 to 6:1. The high concentrate feed intake increased weight gained during 2 to 4 months and absence of space to run around caused 41.20% mortality, 35.30% dead by leg deformation and 5.90 % were injury by sharp edges of metal trough. This information was in agreementswith (Kreibich and Sommer, 1995 and More, 1996).

IV. CONCLUSION

The productive performance of ostriches under treatment group 3 was found better results in all parameters. Extra addition of 0.5% methionine and 1.2% lysine with the formulated concentrate feed has showed numerically higher growth compared to other levels.

V. ACKNOWLEDGEMENTS

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