RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

4.1. First Experiment: Evaluation of the sunflower efficiency as a source of protein and energy in broiler's rations:

4.1.1. Proximate analysis of sunflower raw and processed seeds as well as meal:

Data presented in table (6) showed that proximate analysis of sunflower as raw material or heat treated and meal. Analysis was carried out to illustrate the proportional content of crude protein, ether extract, crude fibre, ash and nitrogen free extract which together give a good indication to the nutritive value.

Inespecting these data it could be stated that heat processing of sunflower seed resulted in increasing its content of nitrogen free extract, while crude protein, ether extract, crude fibre and ash mostly decreased (table 6) .

The rate of decrease in crude protein and ether extract was relatively higher in applying dry heat than steam heat. Opposite results were found in crude fibre and ash. Whereas they decreased with relatively higher rate in steam heated than in dry heated seeds.

The previously mentioned results enable to suggest that variations found in the proximate analysis between raw sun-

flower seeds and those treated with either steam or dry heat may be attributed to the change occurred in the water content of treated seeds as a result of heat treatment. It is scientifically logic to found difference in various ingredients in sunflower seeds treated with steam heat and those of dry heating treatment, that may be due to the amount of moisture lost as a result of heating, which was relatively higher in dry heating. This may have a pronounced reflection on the proportional content of different ingredients. In addition nitrogen free extract was the ingredient which showed higher response to heat processing. This is quite logic since it is a water soluble ingredient and more affected with the amount of water lost during heating process.

On the other hand, sunflower meal showed great variation in all ingredients when compared with the raw seeds. Sunflower meal was characterized by its low content of fat (ether extract) and its higher content of crude protein, crude fibre, ash and nitrogen free extract. In other words, it could be stated that, extracting sunflower oil from seed gives meal that contains more relative amount of crude protein, crude fibre, ash and nitrogen free extract with 39.4, 41.5, 6.76 and 116.6 %, respectively.

The value of proximate analysis of sunflower seeds obtained in the present study goes in partial agreement

with that reported by Singh and Prasad, 1979; Daghir et al., 1980 and Lee and Lee, 1982.

Differences existed in some values may be attributed either to the strain or agricultural variety of the sunflower or to the environmental condition during cultivation.

Finally it could be great usefulness to recommend that great attention must be paid to the proximate analysis of sunflower raw and heat treated seeds as well as sunflower meal in formulating different poultry diets.

Table 6: Proximate analysis of sunflower raw and processed seeds as well as meal (on dry matter basis).

Treatments	Percentages				
	CP	EE	CF	Ash	NFE
Raw sunflower	21.32	41.61	20.3	5.92	10.85
Steam H. seeds 15 min.	21.24	40.62	19.37	5.65	13.12
Steam H. seeds 30 min.	20.86	40.45	18.95	5.57	14.17
Dry H. seeds 15 min.	20.82	40.43	19.52	5.75	13.48
Dry H. seeds 30 min.	20.65	40.04	19.81	5.92	13.58
Sunflower meal	29.72	12.53	28.73	5.52	23.5

4.1.2. Evaluation of total protein efficiency of sunflower raw and processed seeds and meal :

The definite test for the nutritional quality of any given protein aimed to be tested as considered a biological assay. Growth test may be of great necessity for the determination of the ultimate quality of whole sunflower proteins and the adequacy of sunflower processing under investigation.

Data listed in Table (7) presented the mean values (± SE) for each of weight gain, protein intake and total protein efficiency of the experimental rations.

It is obviously clear that treating sunflower seeds with either steam or dry heating, relatively, decreased its total protein efficiency. This was quite true in all periods of heating except in 15 minutes steaming. This may be due to the protein denaturation as a result of heat processing which made it either of lower digestibility (see table 9) or absorbing ability.

The superiority of data of steam heated seeds for 15 minutes (2.37 ± 0.03) may be attributed to the fivourite effect of this treatment in increasing the protein digestibility which is reflected as an increase in total protein efficiency value. The increasing serum protein level in chicks fed on this ration is logic to the suggested statement (see table 11).

It is well known that the serum blood protein is a reflection for the rate of observation through the intestinal villi which is correspondingly a result of higher digestibility.

Comparing steam heating with dry heating treatments, it could be stated that dry heated seeds of any given period had relatively lower total protein efficiency values (1.88 ± 0.04 & 1.71 ± 0.03) when compared with there corresponding period of the steam heated seeds (2.37 ± 0.03 & 1.93± 0.04, respectively). In addition in both two heating treatments it was found that, total protein efficiency decreased markedly as time of heating increased. This may lead to conclude that heating seeds decreased their total protein efficiency with higher rate in case of applying dry heating method than applying steaming.

From the previously mentioned results it is easily to recommend that, it is preferable to subject the sunflower seeds to a steaming heat for 15 minutes if a higher total protein efficiency is aimed to be attained.

Sunflower meal showed relatively similar value of total protein efficiency as did the raw sunflower seeds (Duncan multiple range test table7). This may enable to state that decreasing the fat content of the sunflower seeds from 41.40 to 12.53% during the process of oil extraction did not significantly affected the total protein efficiency of

the meal produced. So from the economic side of view it is of great importance to recommend a sunflower meal in formulating broiler rations rather than raw seeds.

Analysis of variance for obtained data showed significant ($P<0.01$) variation in total protein efficiency due to treatment applied, (ANOVA Table 8).

There is a general agreement in the literature (Renner et al. 1953 and Rad & Keshavarz, 1976) that both of net protein value and metabolizable energy of sunflower seed meal decreased with increasing the processing temperature.

Smith (1968) and Scott et al (1969) indicated that processing temperature had determinetal effect on amino acids availability of sunflower seeds protein in general. However, Daghir et al (1980) found that, steam or dry heated did not have neither detrimental nor beneficial effect on the utilization of sunflower seed by broilers. They added that, dry heated sunflower seed full- fat raw produced slightly lower body weights.

Table 7: Average (± SE) of calculated value of total protein efficiency for the various rations applied at 28th. day.

Treatment \ Parameters :	Weight gain (gm.)	Protein intake (gm.)	Total protein efficiency
Control group	c 229.40 ± 2.59	c 123.69 ± 3.48	c 1.85 ± 0.04
Raw sunflower seeds	c 232.12 ± 7.89	bd 111.57 ± 1.89	d 2.08 ± 0.04
Steam heated seeds (15 min.)	e 266.67 ± 5.78	bd 112.48 ± 2.73	a 2.37 ± 0.03
Steam heated seeds (30 min.)	b 205.46 ± 3.15	b 106.64 ± 3.36	ce 1.93 ± 0.04
Dry heated seeds (15 min.)	c 235.76 ± 3.49	c 125.64 ± 3.85	ce 1.88 ± 0.04
Dry heated seeds (30 min.)	b 200.61 ± 8.16	cd 117.42 ± 3.21	b 1.71 ± 0.03
Sunflower meal	a 291.82 ± 7.94	a 145.56 ± 0.06	de 2.00 ± 0.05

N.B., Means of the same column bearing different letters differed significantly.

Table 8: ANOVA for data presented in table (7)

S.O.V.	d.f	Mean Squares		
		Weight gain	Protein intake	Total protein efficiency
Bet. T.	6	3143.6203**	505.1865**	0.1321**
Bet. R.	2	20.1785	42.9153	0.0007
Error	12	123.7133	22.8328	0.0057

** Significant at level 0.01.

4.1.3. Digestion coefficient and metabolizable energy for rations applied of total protein efficiency determination:

The mean values of digestion coefficient and metabolizable energy of the different diets applied are presented in table (9).

It was found that, the digestion coefficient of crude protein ranged from 58.04 to 69.14 % being the higher in ration containing steam heated sunflower seed (for 15 minutes), followed by that containing full-fat raw sunflower seed (63.17%). However the lowest coefficient value was observed in ration containing dry heated sunflower seed (for 30 minutes).

No significant difference in digestion coefficients value of crude protein between diets containing full-fat raw sunflower seed and either that contained steam heated sunflower seed for 30 minutes or that containing sunflower meal. Similarly significant difference in digestion coefficient value could not be detected between diet containing steam heated sunflower seeds (30 minutes) and that contained either sunflower meal or dry heated sunflower seed (15 minutes), (Duncan's multiple range test, see table 9).

The lowest digestion coefficient value for crude protein of diets containing sunflower seeds treated with dry heat for either 15 or 30 minutes may be attributed to the

protein denaturation which may occur as a result of heat treatment.

Analysis of variance for data concerning the digestion coefficient of ether extract for various experimental diets revealed significant ($P<0.01$) variation in this estimation due to diets applied (ANOVA Table 10). The highest digestion coefficient was observed in diets containing steam heated sunflower seeds for either 15 or 30 minutes. Similar value was also found in diet containing dry heat seeds for 15 minutes. However, diet free of sunflower seeds but contained soya bean showed relatively the lowest coefficient value of ether extract digestibility, which was of no significant difference than the corresponding value but in diets contained either dry heated sunflower seeds for 30 minutes or sunflower meal (table 9).

From the previously mentioned result it is impossible to state any characterized trend concerning the effect of the seed processing on the digestion coefficient of ether extract. However, the variation existed in this estimation between diets may be attributed to the cumulative effect of the various ingredient of the diet on its platability and correspondingly on the neural and hormonal stimulation of the digestive hormones which influence the rate of different digestion juices secretion.

The digestion coefficients of crude fibre ranged from 11.0% to 14.75%. However, no significant variation was found due to diets applied.

Regarding the nitrogen free extract, it was found that, its digestion coefficient value was markedly higher in diets containing sunflower steam heated seeds for 15 minutes (82. 25%), followed by the corresponding values of the other experimental diets which were of approximately similar values (Duncan's multiple range test, see table 9).

Analysis of variance revealed that, there were significant variation in this trait due to diets applied (ANOVA Table 10).

Concerning the digestion coefficients of organic matter, approximately similar results were found to be ranged from 66.23 to 73.73% being the highest for which diet containing sunflower seed steam heated for 15 minutes (73.73%), followed by diet containing corn-soyabean (70.50%). However the value of digestion coefficient for the other experimental diets were approximately similar (Duncan's multiple range test, see table 9)

The metabolizable energy in the feed is the most reliable estimate in evaluating poultry diets which is considered the most practical index in such kind of studies. The determined metabolizable energy value of different experimental diets ranged from 3.0028 Kcal./gm. diet con-

taining dry heated sunflower seeds for 15 minutes to 3.2329 Kcal./gm. diet containing steam heated sunflower seeds for 15 minutes (table 9).

Differences in metabolizable energy value between diet containing steam heated sunflower seeds for 15 minutes and other experimental diets were significant (Duncan multible range test).

From the previously mentioned results, it could be stated that, steam heated sunflower seeds for 15 minutes was the best diet showing the highest value of digestion coefficient and metabolizable energy which lead to recommend this kind of processing on sunflower seeds if good digestion coefficient result were planed to be obtained.

Results obtained agree to a satisfactory extent with those of Rad and Keshavarz (1976) and Daghir et al (1980). They reported that, metabolizable energy was 2952 kcal./kg. for diet containing either 17.48 or 26.22% sunflower meal, and 3035 kcal./kg for the broiler diets containing 30% full-fat raw sunflower seeds, respectively.

Table 9: Digestion coefficient and estimated ME of experimental diets

Diets	Digestion coefficient (%) of					ME
	CP	EE	CF	NFE	OM	kcal/gm.
Control group	c 64.47 ± 0.10	b 66.79 ± 1.95	11.00 ± 0.56	b 75.68 ± 1.62	c 70.50 ± 1.23	b 3.0424 ± 0.03
Raw sunflower seeds	cd 63.17 ± 0.57	cd 74.10 ± 0.68	11.85 ± 1.19	b 75.44 ± 0.91	b 66.89 ± 0.43	b 3.0076 ± 0.01
Steam-heated seeds for 15 min.	a 69.14 ± 1.32	a 83.63 ± 1.11	14.75 ± 0.97	a 82.25 ± 1.22	a 73.73 ± 0.72	a 3.2329 ± 0.03
Steam-heated seeds for 30 min.	cde 62.11 ± 0.29	a 84.82 ± 1.13	11.12 ± 1.52	b 72.50 ± 2.11	b 67.16 ± 1.62	b 3.0057 ± 0.04
Dry-heated seeds for 15 min.	be 59.29 ± 2.43	a 84.97 ± 2.24	12.60 ± 0.67	b 77.23 ± 1.32	b 66.56 ± 1.07	b 3.0028 ± 0.03
Dry-heated seeds for 30 min.	b 58.04 ± 0.14	bd 69.76 ± 1.04	13.30 ± 1.81	b 77.10 ± 2.00	bc 68.90 ± 1.29	b 3.0258 ± 0.02
Sunflower meal	bed 61.00 ± 0.64	bd 70.38 ± 2.40	11.54 ± 0.41	b 75.78 ± 1.89	b 66.23 ± 0.93	b 3.0077 ± 0.02

N.B., Means of the same column bearing different letters differed significantly

Table1 ANOVA for data presented in Table(9).

S.O.V.	d.f	Mean Squares					
		CP	EE	CF	NFE	OM	ME
Bet. diet	6	40.4873 **	187.2450 **	5.5577	26.0467 *	22.3914 **	0.0209 **
Bet. reb.	2	3.3960	6.6465	2.7256	11.7337	3.6213	0.0008
Error	12	3.1944	8.2130	3.9816	7.4017	3.1560	0.00026

* Significant at level 0.05.

** Significant at level 0.01.

4.1.4. Metabolic parameters in blood serum:

4.1.4.1. Serum total proteins, albumen and globulin:

Average of serum total protein, albumen and globulin content (in gm./ 100ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds were listed in table (11).

Results obtained showed that, average serum total protein, albumen and globulin contents increased as birds grew older. This was quite true in all experimental groups. However, rate of increment differed according to treatments applied. It is whatever the heat treatment was (steam or dry heated) seeds treated for 15 minutes showed relatively best result concerning serum total proteins, albumen and globulin content for chicks.

Analysis of variance showed highly significant ($P<0.01$) variation in serum total protein, albumen and globulin due to birds age (ANOVA Table12).

Many investigators were reported that, serum total protein, albumen and globulin in chickens increased with advanced in age (Grimbergen and Kuiken,1963; Huston and Subhas,1968; Kumar et al.1974 and Shim et al., 1979).

Concerning serum total protein at 28 days, it was found that, the higher serum total protein level was obtained in chicks fed diets containing sunflower seeds treated with either steam or dry heating for 15 minutes (4.34 and 4.18

gm./ 100ml., respectively) when compared with the corresponding groups receiving seeds but heated for 30 minutes (3.70 and 3.71 gm./100 ml., respectively), (table11).

On the other hand, the lower averages of total serum protein content was observed in the groups of chicks fed sunflower meal (3.80 gm./ 100 ml.). In addition, it is interesting to state here, that feeding broiler chicks diets containing raw sunflower seeds showed similar effect (4.03 gm./ 100 ml.) as did diets free of sunflower seeds but contained corn-soyabean diet instead (4.14 gm./100 ml.)

Similar trend was noticed in either serum albumen or globulin content at the same age. It was clearly shown that, serum albumen level decreased as heating time increased, being 1.81 and 1.54 gm./ 100 ml. at 15 minutes and 1.53 & 1.48 gm./ 100 ml. at 30 minutes for steaming and dry heated seeds diets, respectively.

On the other hand, higher serum albumen level was observed in chicks fed diets containing sunflower steam heated seeds for 15 minutes (1.81 gm./ 100 ml.). However, lower level was found in birds fed diets containing sunflower dry heated seeds for 30 minutes (1.48 gm./ 100 ml.), while diets contained raw sunflower seeds and sunflower meal showed intermediate and approximately similar values for serum albumen content (1.60 and 1.63 gm./ 100 ml., respectively).

For serum globulin, it was found that, the higher level was observed in birds (at 28 days of age) received diets containing sunflower dry heated for 15 minutes (2.64 gm./ 100 ml.). Lower serum globulin level (2.17 gm./ 100 ml.) was found in those fed diets containing sunflower steam heated seeds for 30 minutes, followed by that of the group of birds treated with diet containing sunflower dry heated seeds for 30 minutes (2.23 gm./ 100 ml.), while other treatments showed associated values.

However, the statistical analysis (ANOVA Table 12) revealed no significant differences in total protein, albumen and globulin due to treatments.

In agreement with the obtained results, Mehrez et al. (1982), who reported that, the total protein was 4.01 and 4.25 gm./ 100 ml. at 4 weeks when Dokki4 chicks were fed on 17% and 19% crude protein in their diets, respectively. The corresponding values for RIR chicks were 3.40 and 3.55 gm./ 100 ml.

On the other hand, Morgan and Glick, (1972) showed that, the total protein content of serum from normal New Hampshire birds significantly increased as the age of the birds increased (2.68 gm.% at 1 week of age to 4.63 gm.% at 12 weeks of age).

Table 11: Average of serum total protein, albumen and globulen content (in gm./100 ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatment	Average serum content in gm./100 ml. (X ± SE) of					
	Total protein		Albumen		Globulen	
	14 day	28 day	14 day	28 day	14 day	28 day
Control group	2.95 ± 0.03	4.14 ± 0.10	1.44 ± 0.02	1.73 ± 0.12	1.63 ± 0.06	2.42 ± 0.02
Raw sunflower	2.88 ± 0.04	4.03 ± 0.51	1.46 ± 0.02	1.60 ± 0.09	1.62 ± 0.02	2.44 ± 0.43
Steam heated seeds 15 min.	2.91 ± 0.03	4.34 ± 0.27	1.53 ± 0.02	1.81 ± 0.12	1.56 ± 0.02	2.53 ± 0.17
Steam heated seeds 30 min.	2.85 ± 0.03	3.70 ± 0.27	1.46 ± 0.02	1.53 ± 0.12	1.55 ± 0.02	2.17 ± 0.17
Dry heated seeds 15 min.	2.87 ± 0.05	4.18 ± 0.15	1.50 ± 0.02	1.54 ± 0.02	1.56 ± 0.02	2.64 ± 0.15
Dry heated seeds 30 min.	2.87 ± 0.01	3.71 ± 0.11	1.51 ± 0.02	1.48 ± 0.05	1.59 ± 0.03	2.23 ± 0.16
Sunflower meal	2.92 ± 0.03	3.80 ± 0.19	1.47 ± 0.02	1.63 ± 0.09	1.58 ± 0.04	2.30 ± 0.42

Table12: ANOVA for data presented in Table(11)

S.O.V.	d.f	Mean Squares		
		Total Protein	Albumen	Globulen
Bet. T.	6	0.1078	0.0207	0.0576
Bet. A.	1	12.5953 **	0.1867 **	6.5057 **
Bet. R.	2	0.0781	0.0021	0.0765
TXA	6	0.871	0.0240	0.0486
Error	26	0.1080	0.0142	0.0653

** Significant at level 0.01

4.1.4.2. Total lipids:

Data presented in Table (13) shows the average of serum total lipids content for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Feeding chicks diet containing heat processed sunflower seeds decreased serum level of total lipids as chicks grew older with great rate as heat processing time increased and in dry heated seeds than steam heated one.

However, obvious increase was observed in serum total lipids level by advancing age in case of feeding chicks control diet and diets containing raw seeds or sunflower meal. The rate of increment was greater in chicks fed raw seeds diet followed by control group, then by those fed sunflower meal (table13).

Analysis of variance did not reveal any significant variation in serum level of total lipids due to estimation periods. This may be scientifically logic since the level of lipid metabolism depends mainly on the chick's requirements which are thought to be of no considerable change throughout the 14 days (14 to 28 days) of the early age of the chicks.

Concerning to treatment effect, it was found to differ according to estimation period. At the 14th day of chicks age, chicks fed diet contained sunflower meal showed the highest serum total lipids level (0.81 gm./ 100 ml.) which

was approximately equal to the level found in serum of those fed dry heated seeds for 30 minutes (0.80 gm./ 100ml.).

However the lower total lipid levels was found in serum of chicks of control. Steam heated seeds of either 15 or 30 minutes and dry heated seeds for 15 minutes had all similar average of 0.77 gm./ 100 ml., and was not greatly different than the level found in serum of chicks fed raw seeds (0.78 gm./ 100 ml.).

Different results were found at the 28th day of chicks age. The highest serum total lipids level was found in chicks fed raw seeds (0.98 gm./ 100 ml.) followed by those of control group (0.85 gm./ 100 ml.) and those fed meal (0.84 gm./ 100 ml.). However the lowest levels were found in serum of chicks fed steam heated seeds for 30 minutes which was not greatly lower than the level of those fed dry heated seeds for 15 or 30 minutes which had similar value of serum total lipid of 0.70 gm./ 100 ml.

Regardless the effect of age, chicks fed diet containing raw seeds showed the highest grand average of serum total lipids (0.88 gm./ 100 ml.) which was not significantly different than that of chicks of control group (0.81 gm./ 100 ml.), or of chicks fed sunflower meal (0.82 gm./ 100 ml.), (Duncan's multiple range test).

Analysis of variance showed significant ($P<0.05$) variation in serum total lipids content due to treatments applied (ANOVA Table14).

4.1.4.3. Serum cholesterol:

Serum cholesterol level decreased as chicks grew older. This was quite true in all groups except that of chicks fed diet containing raw sunflower seeds which showed a slight increase in this trait by advancing age (table13).

The decrease observed in serum cholesterol level by advancing age may be attributed to the relatively higher biosynthesis of the sterol hormonal and bile juice in the young age which result in the higher rate of cholesterol chefted from the blood serum to the liver or the adrenal cortex. However the rate of cholesterol absorption through the intestinal villi may affect the level in the blood serum. It was obviously clear that heat processing may affect the rate of cholesterol absorption which affected its level in blood serum.

Analysis of data showed significant effect ($P<0.01$) due to birds age on serum cholesterol content (ANOVA Table14).

Differences between averages of serum cholesterol content for chicks fed diet contained processed seeds (steam or dry heated) or sunflower meal were of no significant values (Duncan's multiple range test) and ranged from 162.14 to 178.83 mg./ 100 ml.

Analysis of variance indicated significant variation ($P<0.01$) in serum cholesterol content due to treatments applied (ANOVA Table14).

The interaction effect between treatment and bird's age was significant (P<0.01) ANOVA Table14. This may lead to conclude that the effect of treatment differed according to bird's age. This was quite clear when comparing the rate of decrease in serum cholesterol level within treatments. The greatest rate of decrease was found in steam heated seeds for 30 minutes (66.65 mg./ 100 ml.) and dry heated seeds for 15 minutes (64.19 mg./ 100 ml.) while the lowest rate was observed in control birds (15.3 mg./ 100 ml.).

Results obtained, agree with those obtained by Rodbard et al.(1951), who found that, serum cholesterol level decrease by advancing age.

Table13:Average of serum total lipids and cholesterol content for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds

Treatment	Average serum content (X ± SE)			
	Total lipids (gm./100 ml.)		Cholesterol (mg./100 ml.)	
	14 day	28 day	14 day	28 day
Control group	0.77 ± 0.01	0.85 ± 0.03 ab	192.10 ± 0.81	176.80 ± 10.40 c
Raw sunflower	0.78 ± 0.03	0.98 ± 0.01 a	192.69 ± 0.63	210.05 ± 7.49 a
Steam heated seeds 15 min.	0.77 ± 0.01	0.76 ± 0.09 b	194.66 ± 2.27	137.35 ± 7.55 b
Steam heated seeds 30 min.	0.77 ± 0.02	0.69 ± 0.05 b	195.96 ± 1.76	129.31 ± 6.03 b
Dry heated seeds 15 min.	0.77 ± 0.02	0.70 ± 0.10 b	194:24 ± 0.99	130.05 ± 16.98 b
Dry heated seeds 30 min.	0.80 ± 0.01	0.70 ± 0.04 b	192.18 ± 0.88	165.48 ± 11.25 bc
Sunflower meal	0.81 ± 0.01	0.84 ± 0.05 ab	196.33 ± 1.43	144.93 ± 11.11 bc

N.B., Means of the same column bearing different letters differed significantly.

Table14: ANOVA for data presented in Table(13).

S.O.V.	d.f.	Mean Squares	
		Total lipids	Cholesterol
Bet. T.	6	0.0189 *	1217.332 **
Bet. A.	1	0.0006	14957.494 **
Bet. R.	2	0.0023	133.917
(T x A)	6	0.0171 *	1441.4035 **
Error	26	0.0063	176.4118

** Significant at level 0.01

* Significant at level 0.05

4.1.4.4. Serum glucose level :-

Glucose level in blood serum was taken as a parameter for carbohydrate metabolism in the experimental birds. Data concerning this parameter were listed in table (15).

Results obtained, indicated that, serum glucose level decreased as chicks grew older. The rate of this decrease differed according to treatment applied. Chicks fed diets containing either heated seeds or meal showed a higher rate of decrease when compared with control birds or those fed raw sunflower seeds.

Analysis of variance showed highly significant effect ($P<0.01$) due to birds age in serum glucose content (ANOVA Table 16).

The present results go in a harmony with those of Abd-Elmoty et al. (1986), who reported a significant decrease in glucose level in blood serum of Lohmann Selected Leghorn (LSL) layers with advancing age.

In addition El-Ansary et al. (1981) reported that the concentration of blood glucose tended to decrease in Alexandria and Fayoumi chicks as their body weight became hevier by advancing age. However, they added that, the rate of this decrease slowered as the birds grew older.

The higher serum glucose level was found at the 28th day of age in chicks fed control diet (320.48 mg./100 ml.), followed by those fed diet containing raw sunflower seeds

(318.42 mg./100 ml.). While the lowest average was observed in chicks receiving diet containing steam heated seeds for 30 minutes (296.21 mg./100 ml.) at the same age.

Different results were observed at the 14th day of age. At this time, slight differences were found in serum glucose level between different experimental groups. This may be attributed to the individual variation in the rate of metabolic processes, which is relatively low, since the experimental birds are considered genetically homogeneous.

No significant variations were found in serum glucose content due to the interaction between treatments and age, (ANOVA Table16).

Table15:Average of serum glucose content (in mg./100 ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatments	Average serum glucose content X ± SE in mg./100 ml.	
	14 day	28 day
Control	331.30 ± 1.25	320.48 ± 3.22
Raw seeds	330.51 ± 1.04	318.42 ± 1.31
Steam-heated seeds 15 min.	330.85 ± 1.62	311.02 ± 6.63
Steam-heated seeds 30 min.	330.78 ± 1.64	296.21 ± 7.03
Dry-heated seeds 15 min.	331.93 ± 2.43	299.80 ± 5.05
Dry-heated seeds 30 min.	332.70 ± 1.85	307.90 ± 7.81
Sunflower meal	331.35 ± 1.31	305.76 ± 1.62

Table16: ANOVA for data presented in Table(15)

S.O.V.	d.f.	Mean Squares
		Glucose
Bet. T.	6	117.0205
Bet. A.	1	5473.379 **
Bet. R.	2	23.334
(T x A)	6	126.1577
Error	26	47.4979

** Significant at level 0.01

4.1.4.5. Serum alkaline phosphatase and transaminases :-

Serum content of alkaline phosphatase and transaminases were determined as indicators for enzymatic activity related to metabolic level and liver function, as well. Data concerning this aspect was listed in table(17).

No variations in alkaline phosphatase were observed due to either treatments applied, chicks age or the interaction between both of them. This is scientifically logic, since this enzyme acts in a wide range on monoesters of orthophosphoric acid in addition the specific pattern of this enzyme is, to hydrolyse the amidophosphate link of creatine phosphate (Dixon and Webb, 1964) and acts in the process of glucose glycogen conversion and vice versa, (Bell et al., 1972). All these are related to the physiological state of an individual bird and to its biological needs of energy, rather than any other factor.

In addition, Raco et al. (1964) reported that, since alkaline phosphatase activity was reduced with a lowered serum calcium level, so it may have a special part in the metabolism of calcium and phosphorus in birds.

On the other hand, variation in serum transaminases due to treatments differed according to its type. While GOT was found to be affected with treatment ($P<0.05$), GPT didn't, (ANOVA Table18).

This may lead to conclude that the way of transamination differed according to type of amino acids in the dietary protein.

At the 28th day of chicks age the higher serum content of GOT was found in chicks fed diet containing dry heated seeds for 30 minutes and sunflower meal (141.33 and 140.00 U/ml., respectively). While the lowest value (111.67 U/ml.) was observed for chicks fed diet containing sunflower steam heated seeds for 15 minutes.

Concerning serum GPT, the higher value (14.33 U/ml.) was observed in control birds, while the lowest serum GPT content (12.33 U/ml.) was found in chicks fed diet containing sunflower steam heated seeds for 15 minutes. There were no significant differences between all experimental groups in serum GPT content.

Analysis of variance showed a significant differences ($P<0.01$) due to birds age in serum GOT and GPT content (ANOVA Table18).

The rate of increase according to age of birds differed in GOT than GPT. The higher rate was found in GOT for birds fed diet containing sunflower dry heated seeds for 30 minutes while the lowest rate was found in chicks fed diet containing steam heated seeds for 15 minutes (59.38 % and 22.71 %, respectively). The higher GPT level was observed in chicks fed diet containing dry heated seeds for 15 min-

utes while the lowest rate was observed in chicks fed dry heated seeds for 30 minutes.

The interaction between treatment and age had significant effect on GOT ($P<0.05$), only.

No literature are available concerning the normal levels of either GOT or GPT in the blood serum of chicken, so its of great difficulty to attribute the increase occurred in the level of transaminases either to metabolic activity or to the cell distructure as a result of liver fibrosis. However, Sherlock (1975) reported that, transaminases increased reflect impairment in liver function.

Table 17: Average of serum alkaline phosphatase, GOT and GPT content (liver function) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatments	Average serum content (X ± SE)					
	Alk.Phosph. IU/100 ml.		GOT U/ml.		GPT U/ml.	
	14 day	28 day	14 day	28 day	14 day	28 day
Control	50.43 ± 0.40	49.57 ± 1.41	91.00 ± 2.31	131.33 ± 6.69 ac	5.67 ± 0.88	14.33 ± 0.88
Raw seeds	50.65 ± 0.25	50.31 ± 2.03	90.00 ± 3.21	122.67 ± 4.81 ae	6.00 ± 0.58	14.00 ± 0.58
Steam heated seeds 15 min.	49.83 ± 0.23	50.49 ± 0.18	91.00 ± 3.21	111.67 ± 1.76 bcde	5.33 ± 0.33	12.33 ± 1.86
Steam heated seeds 30 min.	49.53 ± 0.33	48.52 ± 1.20	90.67 ± 4.37	128.67 ± 6.12 ad	5.33 ± 0.33	13.33 ± 0.88
Dry heated seeds 15 min.	48.93 ± 0.90	50.51 ± 0.65	89.33 ± 2.19	119.33 ± 4.70 bcde	5.00 ± 0.58	13.00 ± 1.00
Dry heated seeds 30 min.	50.10 ± 0.52	50.22 ± 0.58	88.67 ± 2.96	141.33 ± 7.67 a	5.67 ± 0.67	12.67 ± 2.67
Sunflower meal	48.65 ± 0.69	50.33 ± 0.67	91.00 ± 3.51	140.00 ± 4.58 a	5.33 ± 0.88	13.67 ± 0.67

N.B., Means of the same coluan hearing different letters differed significantly

Table 18: ANOVA for data presented in Table (17).

S.O.V.	d.f.	Mean Squares		
		Alk. Phosph.	GOT	GPT
Bet. T.	6	1.4421	181.2063 *	1.2698
Bet. A.	1	0.7255	14859.5237 **	648.2143 **
Bet. R.	2	0.2606	23.2380	2.1667
(T x A)	6	1.7917	173.1905 *	0.6032
Error	26	2.4853	63.1355	3.7051

* Significant at level 0.05

** Significant at level 0.01

4.1.4.6. Serum Uric acid and creatinine:-

Data concerning the effect of treatments applied on serum uric acid level and serum creatinine was listed in table (19).

Inspection of data showed that serum uric acid was significantly affected with treatment applied ($P<0.05$). After 14 days of feeding birds experimental diets, the highest serum uric acid level was observed in case of applying either raw seeds or steam heated ones for 30 minutes, in chick's diet, which was approximately similar in the two cases (5.12 and 5.14 mg./100 ml., respectively). On the other hand, slight differences were found between other groups in serum blood uric acid which ranged from 4.47 to 4.88 mg./100 ml.

Generally, it could be concluded that, no characteristic trend was found concerning the effect of diets applied on serum uric acid content. It is quite logic, since uric acid is the end product of protein metabolism which is mainly affected by the level of dietary protein content rather than any other factor.

Serum uric acid content was found to be a function of chick's age. It increased as chicks grew older. It was quite true in all experimental groups but with different rates. The higher rate of increase was attained in the group of chicks fed raw seeds while the lowest rate was

observed in those fed steam heated seeds for 15 minutes. The serum uric acid increased by 15.10 % and 0.22 % in the previous two cases, respectively.

Analysis of variance showed significant effect of age on serum uric acid. In addition, significant variations were found due to the interaction effect between treatments and age (ANOVA Table20).

Okumura and Tasaki (1964), found a wide fluctuations in serum uric acid levels, which had been associated with the protein content of the diet and the time of blood sampling. In addition, serum uric acid depended also on the differences in amino acid balance of diets. The same author's (1969) added that, the rapid changes in blood uric acid are further evidence of the interdependence of food intake and growth.

Concerning serum creatinine content at the 28th day of age, the higher value (1.58 mg./100 ml.) was observed in control birds, while the lowest value (1.34 mg./100 ml.) was found in chicks fed diet containing sunflower steam heated for 15 minutes.

The rate of either increase or decrease in serum creatinine by advancing age differed according the experimental groups. Generally it could be concluded that, no characteristic trend was found concerning the effect of diets applied on serum creatinine content.

However, no significant effect was found due to either treatments applied, chick's age or the interaction between both of them (ANOVA Table 20).

Table 19: Average of serum uric acid and creatinine content (in mg/100 ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatments	Average serum content (X ± SE)			
	Uric acid		Creatinine	
	14-day	28-day	14-day	28-day
Control	4.47 ± 0.03	4.79 ± 0.28 ac	1.52 ± 0.02	1.58 ± 0.22
Raw seeds	4.45 ± 0.02	5.12 ± 0.09 a	1.48 ± 0.03	1.37 ± 0.01
Steam heated seeds 15 min.	4.46 ± 0.03	4.47 ± 0.11 bc	1.48 ± 0.01	1.34 ± 0.05
Steam heated seeds 30 min.	4.42 ± 0.02	5.14 ± 0.06 a	1.50 ± 0.04	1.53 ± 0.05
Dry heated seeds 15 min.	4.42 ± 0.04	4.62 ± 0.16 bc	1.53 ± 0.02	1.35 ± 0.01
Dry heated seeds 30 min.	4.44 ± 0.05	4.55 ± 0.13 bc	1.48 ± 0.05	1.51 ± 0.04
sunflower meal	4.44 ± 0.03	4.88 ± 0.16 ac	1.47 ± 0.02	1.35 ± 0.08

N.B., Means of the same column bearing different letters differed significantly.

Table 20 : ANOVA for data presented in Table (19).

S.O.V.	d.f.	Mean Squares	
		Uric acid	Creatinine
Bet. T.	6	0.1025 *	0.0187
Bet. A.	1	1.3002 **	0.0421
Bet. R.	2	0.0047	0.0163
(T x A)	6	0.1133 *	0.0143
Error	26	0.0409	0.0177

* Significant at level 0.05

** significant at level 0.01

4.2. Second experiment:

4.2.1. Live weight and weight gain allover the experimental period:

Data persented in table(21) showed averages of live weight and weight gain for experimental groups of Arbor Acer broiler chicks at the end of the 8th week.

Inspection of these data revealed that both live weight and weight gain increased by increasing the diet content from sunflower seeds. This quiet true in either raw or steam heated seeds with greater rate in raw seeds than steam heated ones. However, Duncan multiple range test did not show any significant differences between averages of either body weight or weight gain for chicks receiving diets containing either 10 or 20% sunflower raw or steam heated seeds (table21).

On the other hand live weight and weight gain were significantly lower in chicks of control group (fed corn-soya diet) than in those of previously mentioned groups of chicks (Duncan multiple range test, table21).

Adding sunflower seeds to broiler diets may improve the digestability of its various ingredients through the neural stimulation of the digestive hormones and consequently through increasing the rate of secretion of various digestive juices which was reflected as improving the final live weight and weight gain of treated chicks.

Diets containing 20% sunflower meal decreased both live weight and weight gain for chicks than did the diet containing 10% sunflower meal only. However averages of live weight and weight gain were higher in chicks fed diets containing sunflower meal (with the rate of 10 or 20%) than controls.

The increasing fiber contents as the percent of sunflower meal increased may be the main reason for lower averages of body weight and weight gain observed in chicks fed diets containing 20% sunflower meal than those fed 10%.

In addition the higher averages of live weight and weight gain for chicks fed sunflower meal (10 or 20%) than controls may be attributed to the increasing the diet palatability which resulted in increasing the amount of feed consumed.

Analysis of variance (Table22) showed significant variation in live weight and weight gain due to treatments applied.

Daghir et al., (1980) partially agreed with the present results, who indicated that, when broiler chicks were fed different levels of sunflower seeds (full-fat raw) at levels of 10, 20 and 30%, a significant reduction in body weight was only observed in birds fed 30%.

In addition, Rico (1978) found that feeding broiler chicks commercial mash supplemented with 10% unprocessed sunflower seeds were significantly increased live body weight.

Table 21: Body weight and weight gain of different treatments at the end of the 8th week of chick's age.

Treatments	Body weight (gm.)	Weight gain (gm.)
Control group	1350.40 ± 94.02 [b]	1231.43 ± 94.00 [b]
Raw sunflower seeds 10%	1583.77 ± 16.95 [a]	1464.60 ± 16.88 [a]
Raw sunflower seeds 20%	1638.33 ± 50.93 [a]	1518.83 ± 50.93 [a]
Steam heated seeds 10%	1537.67 ± 41.92 [a]	1417.57 ± 42.06 [a]
Steam heated seeds 20%	1676.87 ± 47.50 [a]	1557.37 ± 47.50 [a]
Sunflower meal 10%	1676.10 ± 14.79 [a]	1556.60 ± 14.79 [a]
Sunflower meal 20%	1404.77 ± 21.94 [b]	1285.43 ± 21.78 [b]

N.B., Means of the same column bearing different letters differed significantly.

Table 22: ANOVA for data presented in table (21).

S.O.V.	d.f	Mean Squares	
		Body weight	Weight gain
Bet. T.	6	4444639.8594**	445229.1396**
Bet. R.	2	41802.4424	41910.9306
(T X R)	12	69133.1638	69315.6591
Remainder	172	45038.7089	44382.4825

** Significant at level 0.01.

4.2.2. Feed intake and feed efficiency:

Average amounts of feed consumed by different experimental groups of broiler chicks as well as the corresponding averages of feed efficiency were tabulated in table(23).

It was observed that, chicks fed sunflower seeds or meal (with level 10 or 20%) consumed more food than that did controls. However, Duncan multiple range test showed insignificant differences in average feed intake between control chicks (2919 gm./chick/8 weeks), chicks fed diet containing 10% steam heated sunflower seeds (3265 gm./chick/8 weeks) and those fed 20% sunflower meal (3065.33 gm./chick/8 weeks). Similarly, no significant differences were found between averages of feed intake for chicks fed diets containing either raw or steam heated sunflower seeds in the amount of 10% or 20%.

On the other hand the average of feed intake increased as the percentage of sunflower meal decreased. It was 3699.33 and 3065.33 gm./chick/8 weeks in chicks receiving diet containing 10 and 20% sunflower meal respectively. The difference between previously mentioned means, was significant (Duncan multiple range test, Table(23).

Adding sunflower raw or processed seeds as well as meal may improve the ration platability and increase the amount of feed consumed.

Similar average of feed efficiency (0.42) was observed in controls and groups of chicks fed diets containing 10 and 20% sunflower meal. The same results was found concerning the average of feed efficiency in groups of chicks fed 10 and 20% raw sunflower seed which had equal average of 0.44. Higher feed efficiency average (0.46) was observed in chicks fed diet containing 20% steam heated seeds.

Since feed efficiency is the ratio between feed intake and weight gain whose results were not of similar trend. So, it is quiet logic to get unsimilar result between feed intake and efficiency.

Significant variations were found in feed intake ($P<0.01$) and feed efficiency ($P<0.05$) due to treatments applied (ANOVA Table 24).

Valdivie et al., (1982) reported that, feed consumption were 3845 and 3857 gm./bird with final live weight 1325 and 1393 gm./bird when broiler chickens were fed diet containing 10 and 20% sunflower seed meal.

Table 20: Feed intake and feed efficiency of different treatments at the end of the 8th week of chick's age.

Treatments	Feed intake gm./chick	Feed efficiency
Control group	b 2919.00	bc 0.42
Raw sunflower seeds 10%	c 3307.00	ac 0.44
Raw sunflower seeds 20%	ac 3441.67	bc 0.44
Steam heated seeds 10%	bc 3265.00	bc 0.43
Steam heated seeds 20%	ac 3388.33	a 0.46
Sunflower meal 10%	a 3699.33	bc 0.42
Sunflower meal 20%	bc 3065.33	bc 0.42

N.B., Means of the same column bearing different letters differed significantly.

Table24:ANOVA for data presented in table(23).

S.O.V.	d.f	Mean Squares	
		Feed intake	Feed efficiency
Bet. T.	6	194406.700**	0.0006*
Bet. R.	2	29602.850	0.00002
Error	12	39548.5917	0.0002

* Significant at level 0.05.

** Significant at level 0.01.

4.2.3.Parametars of carcass quality:

4.2.3.1. Killing, dressing and eviscerating losses:

Data of killing, dressing and eviscerating losses expressed as absolute and proportional weights of blood, feathers and inedible parts of carcass for experimental groups of Arbor Acer broiler chicks aged 56 days were listed in table(25).

Results obtained showed that absolute and proportional weight of blood ranged from 53.33 gm. & 3.58% (in chicks fed diets containing 10% steam heated sunflower seeds) and 56.67 & 3.39% (in chicks fed diets containing 20% steam heated sunflower seeds) to 63.33 gm. & 4.53% (in chicks fed diet containing 20% sunflower meal), respectively.

Analysis of variance (table26)did not show any significant variation in either absolute or proportional weight of blood. This is scientifically logic since blood weight is affected mainly by the volume of cerculating blood. The later is considered as a function of the physiological status of an individual bird rather than any other factor. It is well known that sexual and thyroid hormones have pronounced effect on blood volume (Campbell, 1959). In addition hypo-or-hyperthermia cause a remarkable changes in plasma volume in chicken (Williams and Rodbard, 1960).

Absolute weight of inedible parts of carcass as well as

their proportional weight showed insignificant response to treatments applied (ANOVA Table 26).

The higher value of absolute weight of inedible meat (223.97 gm.) was found in chicks fed diet containing sunflower raw seeds. While, the lower value (162.77 gm.) was found in chicks fed diet containing 20% sunflower meal.

Different results were found in the proportional weight of the inedible meat. The lower (11.63%) and higher (13.80%) values were found in chicks fed 20 sunflower meal and those of control group, respectively.

Feathers absolute weight was the only trait that showed a significant ($P<0.05$) response to the treatments applied (ANOVA Table 26).

Feeding Arbor Acer broiler chicks diet containing 20% steam heated sunflower seeds increased the absolute weight of feathers which averaged 90 gm.

However, Duncan multiple range test showed insignificant differences between averages of absolute feathers weight of chicks fed either raw or steam heated seeds.

The lower absolute feathers weight (60 gm.) was found in chicks of 20% sunflower meal followed that of controls (63.33 gm.). Differences between these two means was insignificant (Duncans multiple range test).

Changes in absolute weight of feathers due to treatments applied may be attributed to the changes occurred in

the average body weight and the rate of growth which is related to the rate of feathering in the growing chicks.

Results of the proportional feathers weight may support this statement. In all cases it was found that chicks having higher absolute weight of feathers did not have the higher value of proportional weight, since the proportional weight of feathers is a function of both absolute weight of feather and live weight.

In agreement with obtained results, Kahle & Gray (1956) and Lortscher et al., (1957), reported that, the relative weight of blood at 7 weeks old of broiler chicks was 3.1%. On the other hand, Plavnic and Hurwitz, (1983), indicated that, the feathers to live body weight for White Rock broiler chicks at 7 weeks of age was 4.97%.

Table 25 Average of absolute and proportional weights of blood, feathers and inedible parts of carcass for experimental groups of Arbor Acer broiler chicks aged 56 days.

Treatments	Averages of absolute and proportional weights to live body weight "at 56 days of age" ± S.E.					
	Blood		Feathers		Inedible parts	
	Weight (gm.)	%	Weight (gm.)	%	Weight (gm.)	%
Control group	a 56.67 ± 7.33	3.91 ± 0.16	bcd 63.33 ± 3.33	4.40 ± 0.34	a 199.83 ± 8.67	13.80 ± 0.21
Raw sunflower seeds 10%	a 60.00 ± 5.77	3.78 ± 0.47	ad 80.00 ± 5.77	4.99 ± 0.21	a 211.70 ± 34.90	13.12 ± 1.79
Raw sunflower seeds 20%	a 56.67 ± 3.33	3.42 ± 0.10	ad 76.67 ± 3.33	4.64 ± 0.06	a 223.97 ± 32.02	13.56 ± 1.89
Steam heated seeds 10%	a 53.33 ± 3.33	3.58 ± 0.07	ac 83.33 ± 8.82	5.58 ± 0.38	a 192.43 ± 11.62	12.94 ± 0.58
Steam heated seeds 20%	a 56.67 ± 3.33	3.39 ± 0.27	a 90.00 ± 5.77	5.35 ± 0.30	a 197.80 ± 20.66	11.73 ± 0.99
Sunflower meal 10%	a 60.00 ± 5.77	3.71 ± 0.25	ad 80.00 ± 5.77	4.98 ± 0.40	a 221.27 ± 33.08	13.65 ± 1.69
Sunflower meal 20%	a 63.33 ± 6.67	4.53 ± 0.43	bd 60.00 ± 5.77	4.29 ± 0.37	a 162.77 ± 10.44	11.63 ± 0.55

N.B., Means of the same column bearing different letters differed significantly.

Table 26: ANOVA for data resented in table (25).

S.O.V.	d.f	Mean Squares					
		Blood		Feathers		Inedible parts	
		Absolute wt.	%	Absolute wt.	%	Absolute wt.	%
Bet. T.	6	31.746	1.048	349.206*	1.202	1299.189	1.738
Bet. R.	2	90.476	0.350	19.048	0.155	1970.423	2.685
Error	12	76.984	0.369	115.873	0.609	1713.211	3.728

* Significant at level 0.05

4.2.3.2. Absolute and proportional weight of edible meat, carcass and giblets:

The average of absolute and proportional weights of edible meat, carcass and giblets for experimental groups of Arbor Acer broiler chicks were presented in Table (27).

The highest averages of absolute and proportional weights of total edible meat and carcass were found in the group of chicks fed 20% steam heated sunflower seeds when compared with other experimental groups.

Applying raw sunflower seeds with the rate of 10 or 20% had similar effect on total edible meat, carcass and giblets. Duncan multiple range test showed insignificant differences between averages of absolute weight of both total edible meat, carcass and giblets of chicks fed 10 and 20% raw seeds (table 27).

However, applying steam heated seeds with a rate of 20% had the best effect on average of absolute weights of total edible meat and carcass when compared with that of 10%.

Applying sunflower meal in broiler diet decreased the averages of absolute weights of total edible meat and carcass when compared with raw or processed seeds. The rate of decrease was higher as the diet content of sunflower meal increased.

Chicks fed corn-soya diet (controls) had, approximately equal averages of absolute weight of total edible meat,

carcass and giblets as those fed diet containing 20% sunflower meal (table27), but lower average than those fed diets containing 10% sunflower meal.

Analysis of variance for obtained data revealed significant ($P<0.05$) variation in absolute weights of total edible meat and carcass due to treatments applied. However, no significant effect of treatments was found in absolute weight of giblets (ANOVA Table28).

Sullivan et al., (1958) and Orr & Noran, (1975) reported that, the dressing percentage was ranged from 57.6% to 66.2% for broiler chicks at 8 weeks of age. On the other hand, Milovanovic et al., (1972) showed that, dressed carcass weight for Hypro chicks slaughtered at 56 days of age was 1451.5 grams. They added that, giblets weight percentage to carcass was 5.45%.

Table 27 Average of absolute and proportional weights of total edible meat, carcass and giblets for experimental group of Arbor Acer broiler chicks aged 56 days.

Treatments	Averages of absolute and proportional weights to live body weight "at 56 days of age" ± S.E.					
	Total edible meat		Carcass		Giblets	
	Weight (gm.)	%	Weight (gm.)	%	Weight (gm.)	%
Control group	1126.83 ± 31.91 b	77.89 ± 0.05	1060.67 ± 30.33 b	73.32 ± 0.13	66.17 ± 2.94 a	4.58 ± 0.17
Raw sunflower seeds 10%	1248.30 ± 20.96 ac	78.11 ± 1.72	1179.43 ± 19.36 a	73.81 ± 1.64	68.87 ± 1.59 a	4.31 ± 0.08
Raw sunflower seeds 20%	1296.03 ± 53.23 a	78.38 ± 1.90	1223.63 ± 51.48 a	74.00 ± 1.76	72.40 ± 2.57 a	4.39 ± 0.19
Steam heated seeds 10%	1157.57 ± 42.31 bc	77.89 ± 0.52	1091.00 ± 38.74 bc	73.43 ± 0.63	66.57 ± 4.00 a	4.47 ± 0.11
Steam heated seeds 20%	1335.53 ± 25.12 a	79.53 ± 1.08	1258.37 ± 27.43 a	74.92 ± 0.97	77.17 ± 2.40 a	4.60 ± 0.25
Sunflower meal 10%	1248.73 ± 29.09 ac	77.65 ± 1.81	1176.53 ± 29.19 ac	73.16 ± 1.76	72.20 ± 1.07 a	4.49 ± 0.58
Sunflower meal 20%	1110.57 ± 4.13 b	79.55 ± 1.03	1041.73 ± 2.79 b	74.62 ± 1.17	68.83 ± 3.62 a	4.92 ± 0.20

N.B., Means of the same column bearing different letters differed significantly.

Table 28: ANOVA for data resented in table (27).

S.O.V.	d.f	Mean Squares					
		Total edible meat		Carcass		Giblets	
		Absolute wt.	%	Absolute wt	%	Absolute wt.	%
Bet. T.	6	22635.270**	0.9267	20934.525**	0.585	45.199	0.232
Bet. R.	2	216.085	1.1850	1675.770	2.180	41.453	0.225
Error	12	3709.290	2.7433	3249.977	2.128	20.009	0.172

** Significant at level 0.01.

4.2.4. Metabolic parameters in blood serum:

4.2.4.1. Serum total proteins, albumen and globulin:

Average of serum total protein, albumen and globulin contents (in gm./100 ml.) for experimental groups of Arbor Acer broiler chicks were presented in table(29) .

Inspection of obtained data revealed that, in all experimental groups, average of both total proteins, albumen and globulin increased as chicks grew older. The rate of increase differed according to treatment applied. The higher rate of increased was found in groups of chicks fed diets containing 10 or 20% steam heated sunflower seeds followed by those fed sunflower meal with a rate of 10 and 20%. While the lower rate of increase was found in controls. Analysis of variance (table30) showed significant variation in serum total proteins, albumen and globulin contents ($P<0.05$) due to bird's age (ANOVA Table30).

The increase occurred in the level of serum total protein, albumen and globulin contents with advanced age may be attributed to the increase occurred in the level of metabolic processes by advancing age to face the increased growth rate, anabolic processes and immunity acquired.

Results obtained agree with those reported by Grimbergen and Kuiken, (1963); Huston and Subhas, (1968); Kumar et al., (1974) and Shime et al.,(1979). They all reported a significant increase in serum total protein, albumen and

globulin contents as experimental birds grew older.

At the 56th day of chicks age, chicks fed diets containing 20% steam heated sunflower seeds showed the highest serum total proteins (4.93 gm./100 ml.), and albumen (1.88 gm./100 ml.) content averages when compared with those of other experimental groups. The highest average serum globulin content (3.16 gm./100 ml.) was found in chicks fed diet containing 10% steam heated sunflower seeds.

On the other hand, Duncan multiple range test showed no significant differences between averages of total proteins content of chicks fed diet containing 20% raw seeds, 10 and 20% steam heated seeds and 10% sunflower meal. Also, insignifiant differences were found between averages of serum albumen content of control chicks and those fed diets containing 10 and 20% raw seeds, 10% steam heated seeds and 20% meal.

Variations due to treatments applied were found in serum total proteins ($P<0.01$) and albumen ($P<0.05$) contents only. While serum globulin content was not affected.

Mehrez et al., (1982) recorded relatively low levels of serum total proteins at hatching (2.55 and 2.66 gm./ 100 ml.) for Dokki4 and Rhode Island Red, respectively which increased to (4.70 and 5.15 gm./100 ml., respectively) at 12 weeks of age. The rate of increment dependent on the dietary protein level and source.

Table 29: Average of serum total protein, albumen and globulen content (in gm/100 ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatments	Average serum content X ± SE in gm/100 ml.					
	Total protein		Albumen		Globulen	
	7 days	56 days	7 days	56 days	7 days	56 days
Control group	2.52 ± 0.06	bc 4.48 ± 0.16	1.15 ± 0.01	bc 1.70 ± 0.01	1.37 ± 0.06	a 2.79 ± 0.17
Raw sunflower seeds 10%	2.50 ± 0.04	bc 4.42 ± 0.03	1.14 ± 0.02	b 1.67 ± 0.05	1.35 ± 0.03	a 2.75 ± 0.07
Raw sunflower seeds 20%	2.56 ± 0.03	ac 4.66 ± 0.07	1.14 ± 0.01	bc 1.78 ± 0.05	1.43 ± 0.02	a 2.88 ± 0.12
Steam heated seeds 10%	2.55 ± 0.06	a 4.91 ± 0.04	1.14 ± 0.01	bc 1.75 ± 0.03	1.41 ± 0.06	a 3.16 ± 0.07
Steamheated seeds 20%	2.47 ± 0.05	a 4.93 ± 0.12	1.16 ± 0.01	a 1.88 ± 0.06	1.31 ± 0.06	a 3.05 ± 0.14
Sunflower meal 10%	2.52 ± 0.04	a 4.87 ± 0.07	1.16 ± 0.01	ac 1.79 ± 0.01	1.36 ± 0.04	a 3.08 ± 0.06
Sunflower meal 20%	2.48 ± 0.05	bc 5.49 ± 0.11	1.14 ± 0.01	bc 1.72 ± 0.02	1.34 ± 0.07	a 2.87 ± 0.10

N.B., Means of the same column bearing different letters differed significantly.

Table(30): ANOVA for data presented in Table(29)

S.O.V.	d.f	Mean Squares		
		Total Protein	Albumen	Globulen
Bet. T.	6	0.0686 **	0.0084 *	0.0412
Bet. A.	1	49.9002 **	3.8706 **	25.9757 **
Bet. R.	2	0.0093	0.00005	0.0102
(T X A)	6	0.0657 **	0.0060	0.0383
Error	26	0.0180	0.0026	0.0235

* Significant at level 0.05
** Significant at level 0.01

4.2.4.2. Serum total lipids and cholesterol content:

Data listed in table (31) show the effect of experimental diets on the levels of serum total lipids and cholesterol of Arbor Acer broiler chicks along the experimental period.

Results obtained showed that, both serum total lipids and cholesterol contents increased as birds grew older. This was quite true in all experimental groups except the serum total lipids content of controls which decreased slightly towards the end of the experimental period. The rate of increase differed according to parameter estimated and treatment applied.

Generally, it could be noted that a greater rate of increase was observed in the serum cholesterol content when compared with that of serum total lipids. This may be attributed to the increased rate of steroid hormones biosynthesis as broiler chicks grew older.

Significant variations ($P<0.01$) in both serum total lipids and cholesterol content were found due to chicks age (ANOVA Table32).

On the other hand, higher serum total lipids content was observed in the group of chicks fed 10 and 20% raw sunflower seeds, followed by those fed 10 or 20% steam heated seeds. While the low content was observed in the serum of controls . However, analysis of variance did not show any

significant effect of applied diets on serum total lipids content (ANOVA Table 32).

It was noted that treatments applied had a pronounced effect on the rate of serum cholesterol content which increased along the experimental period. The higher rate of increase was observed in serum of chicks fed 20% of either raw sunflower seeds or steam heated ones. Serum cholestrol content increased from 160.96 and 161.55 mg./100 ml. at the 7th day of age to 280.62 and 266.57 mg./100 ml. at the 56th day of age for chicks fed 20% raw and steam heated seeds, respectively. On the other hand, the lower rate of increase was observed in controls. Serum cholestrol content increased in this case from 163.92 mg./100 ml. at the 7th day to 171.72 mg./100 ml. at the 56th day of age.

Significant ($P<0.01$) variation in serum cholesterol level was found due to treatment applied. This may lead to conclude that feeding broiler chicks sunflower seeds (raw or steam heated) or meal with the rate of 10 or 20% of the diet content increase the level of serum cholesterol. This may be a result of increasing growth rate to face the steroidal metabolic hormones biosynthesis.

Faltase et al., (1987) indicated that, exposing the birds at 40 C for four hours resulted in an increase of serum total lipids concentration and a decrease in blood cholesterol concentration. On the other hand, Attia et al.,

(1978) reported that, the plasma cholesterol level was influenced by some factors like fat level and calorie protein ratio of the diet.

Table 31: Average of serum total lipids and cholestrol content for Arbor Acer broiler chicks fed diets containing raw and procerssed sunflower seeds.

Treatments	Average serum content X ± SE			
	Total lipids (gm/100ml.)		cholesterol (mg/100ml.)	
	7 days	56 days	7 days	56 days
Control group	0.75 ± 0.05	a 0.72 ± 0.01	163.92 ± 3.56	b 171.72 ± 7.40
Raw sunflower seeds 10%	0.74 ± 0.04	a 0.92 ± 0.02	162.21 ± 4.08	ce 231.86 ± 7.55
Raw sunflower seeds 20%	0.74 ± 0.05	a 0.95 ± 0.01	160.96 ± 1.69	a 280.63 ± 2.32
Steam heated seeds 10%	0.72 ± 0.04	a 0.88 ± 0.01	158.90 ± 4.43	c 215.64 ± 1.57
Steam heated seeds 20%	0.72 ± 0.04	a 0.87 ± 0.06	161.55 ± 6.08	ad 266.57 ± 4.18
Sunflower meal 10%	0.76 ± 0.03	a 0.83 ± 0.03	158.82 ± 2.98	c 227.24 ± 6.41
Sunflower meal 20%	0.74 ± 0.03	a 0.89 ± 0.05	159.24 ± 4.88	de 255.81 ± 7.20

N.B., Means of the same coluan bearing different letters differed significantly

Table32: ANOVA for data presented in Table (31)

S.O.V.	d.f	Mean Squares	
		Total lipids	Cholesterol
Bet. T.	6	0.0071	1919.4055 **
Bet. A.	1	0.1748 **	58810.019 **
Bet. R.	2	0.0004	29.047
(T X A)	6	0.0097	2070.8688 **
Error	26	0.0040	78.8478

** Significant at level 0.01

4.2.4.3. Serum glucose content:

Data presented in table(33) show the average of serum glucose content of experimental groups of Arbor Acer broiler chicks along the period of 56 day.

It was clearly noted that the level of serum glucose decreased as chicks grew older. The rate of decrease differed according treatment applied. The higher rate of decrease was observed in blood serum of chicks fed 20% raw sunflower seeds and those fed 10 or 20% steam heated seeds. While, the lower rate of decrease was observed in chicks fed 10% sunflower meal (table33). Therefore they had the higher average of serum glucose at the 56th day of their age (272.10 mg./100 ml.).

Analysis of variance showed that chick's age had significant ($P<0.01$) effect on the level of blood serum glucose (ANOVA Table 34).

It was observed that, feeding chicks corn-soya diet increase the level of glucose in blood serum than did feeding them diets containing 10 or 20% raw or steam heated sunflower seeds and 20% sunflower meal.

Averages of blood serum glucose were 240.38, 214.90, 216.05, 212.69, 209.97 and 215.04 mg./100 ml. in chicks of control group and those fed 10, 20% raw sunflower seeds, 10, 20% steam heated seeds and 20% sunflower meal, respectively. However, Duncan multiple range test showed no sig-

nificant differences between averages of blood serum glucose level of chicks fed 10 or 20% sunflower raw or steam heated seeds and those fed 20% sunflower meal. Similarly, no significant differences were found between averages of serum glucose content of controls and those fed 20% raw seeds or 10% steam heated seeds.

Significant variation ($P<0.01$) in this trait was found due to treatment applied.

The interaction effect between bird's age and treatment applied was of significant ($P<0.05$) value.

Attia et al., (1978) observed that, a significant decrease in the blood glucose level with the progress of age. this finding was in harmony with those found by Ota and Nally (1961) and El-Ansary et al., (1981). They showed that, blood glucose tended to decrease by the increase in body weight with the advance of age.

Table 33: Average of serum glucose content (in gm/100 ml.) for Arbor Acer broiler chicks fed diets containing raw and procerssed sunflower seeds.

Treatments	Average serum glucose X ± SE in gm/100 ml.	
	X ± SE	
	7 days	56 days
Control group	315.55 ± 8.86	240.38 ± 11.29 c
Raw sunflower seeds 10%	309.18 ± 4.28	214.90 ± 3.41 b
Raw sunflower seeds 20%	319.56 ± 3.41	216.05 ± 0.79 bc
Steam heated seeds 10%	317.19 ± 6.87	212.69 ± 1.28 bc
Steam heated seeds 20%	313.59 ± 3.32	209.97 ± 5.72 b
Sunflower meal 10%	309.91 ± 1.16	272.16 ± 11.02 a
Sunflower meal 20%	310.78 ± 2.00	215.04 ± 6.76 b

N.B., Means of the same column bearing different letters differed significantly.

Table34: ANOVA for data presented in Table(33)

S.O.V.	d.f	Mean Squares
		Glucose
Bet. T.	6	717.2237 **
Bet. A.	1	80941.942 **
Bet. R.	2	17.972
(T X A)	6	886.4397 **
Error	26	117.0370

** Significant at level 0.01

4.2.4.4. Serum content of alkaline phosphatase and transaminases:

Averages of serum alkaline phosphatase (IU/100 ml.) and transaminases (GOT and GPT in U/ml.) contents for experimental groups of Arbor Acer broiler chicks were presented in tabl (35).

A- Alkaline phosphatase:

Except in chicks fed diet containing 20% steam heated sunflower seeds, serum alkaline phosphatase content increased as chicks grew older with higher and approximately equal rate in chicks fed diet containing 10 and 20% sunflower meal and 20% raw sunflower seeds (table 35). While control had the lowest rate of increase. The concentration of alkaline phosphatase in blood serum of experimental groups of Arbor Acer broiler chicks was not greatly varied at the 56th day of age. It ranged from 44.46 to 50.09 IU/100 ml.

Analysis of variance showed significant ($P<0.01$) variation in serum alkaline phosphatase content due to bird's age. While there were insignificant effects of treatments applied or the interaction between age and treatments in this trait.

The obtained results are scientifically logic, since blood alkaline phosphatase is considered as an indication of the rate of bone deposition which relatively increases

during the early stages of bird's age (the stage of higher growth rate). The osteoblasts secrete large quantities of alkaline phosphatase when they are activily depositing bone matrix.

B- Transaminases:

Serum blood transaminases (GOT and GPT) level increased obviously as birds grew older. This was quite true in all experimental groups of birds. The rate of increase was relatively higher for GOT than for GPT.

In addition, the rate of increase in serum GOT was approximately equal in all experimental groups except that of 10% sunflower meal which showed the lowest rate of increase.

Different results were obtained in GPT. The rate of increase in its level in the blood serum differed according to treatments applied. The highest rate was observed in controls, while the lower rate found in chicks fed diet containing 10%raw sunflower seeds.

Serum transaminases showed significant ($P<0.01$) response to bird's age while GPT is the only transaminase that was affected with treatments applied.

Changes in serum transaminases may depend mainly on the rate of protein metabolism which may be a function of bird's age rather than any other factor. It is well known

that, by the simple process of transamination, an amino radical is transferred to alfa-keto acid while the keto oxygen is transferred to the donor of the amino radical which is promoted by transaminases (Guyton, 1981).

Table 35: Average of serum alkalin phosphatase, GOT and GPT content for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds

Treatments	Average serum content X ± SE					
	Alk. Phosph. (IU/100ml.)		GOT (U/ml.)		GPT (U/ml.)	
	7 days	56 days	7 days	56 days	7 days	56 days
Control group	45.21 ± 0.46	45.30 ± 3.30 a	92.33 ± 2.40	127.33 ± 3.93 a	6.00 ± 0.58	21.00 ± 0.58 a
Raw sunflower seeds 10%	43.77 ± 1.05	44.46 ± 1.43 a	85.67 ± 2.33	121.33 ± 1.33 a	6.00 ± 0.58	15.33 ± 0.33 bc
Raw sunflower seeds 20%	43.25 ± 0.70	48.07 ± 0.38 a	91.00 ± 3.61	128.33 ± 6.36 a	5.00 ± 0.58	17.00 ± 1.15 b
Steam heated seeds 10%	47.73 ± 1.52	49.01 ± 0.41 a	90.33 ± 3.84	127.33 ± 3.53 a	5.33 ± 0.88	17.67 ± 0.88 bc
Steam heated seeds 20%	45.74 ± 1.90	44.63 ± 0.50 a	92.67 ± 0.88	128.67 ± 5.70 a	4.67 ± 0.33	17.33 ± 0.33 bc
Sunflower meal 10%	45.15 ± 0.91	50.09 ± 0.38 a	89.67 ± 3.71	113.33 ± 4.37 a	5.67 ± 0.88	16.33 ± 0.33 bc
Sunflower meal 20%	43.75 ± 1.10	48.66 ± 0.65 a	91.33 ± 2.40	125.67 ± 7.62 a	5.33 ± 0.33	19.00 ± 0.58 c

N.B., Means of the same column bearing different letters differed significantly

Table36: ANOVA for data presented in Table(35)

S.O.V.	d.f	Mean Squares		
		Alk. Phosph.	GOT	GPT
Bet. T.	6	13.1450	54.7222	6.7063 **
Bet. A.	1	52.3940 **	12240.2142 **	1572.5953 **
Bet. R.	2	1.3415	20.2142	0.0238
(T X A)	6	10.0551	53.8809	4.3730 *
Error	26	5.3899	232.3731	1.3571

* Significant at level 0.05
** Significant at level 0.01

4.2.4.5. Serum uric acid and creatinine level:

Data presented in table(37) shows averages of serum uric acid and creatinine contents (in mg./100 ml.) for experimental groups of Arbor Acer broiler chicks estimated at the 7th and 56th days of their age.

It was clearly noted that serum uric acid level decreased in all experimental birds as they grew older. The rate of decrease differed from treatment to treatment. The higher rate of decreased was found in chicks fed diets containing 10% sunflower meal followed by those fed diet containing 10% steam heated sunflower seeds. On the other hand, the lower rate of decrease was observed in the group of chicks fed diet containing 20% raw sunflower seeds followed by those fed diet containing 20% sunflower meal.

Analysis of variance for obtained data showed significant ($P<0.01$) variation in serum uric acid level due to bird's age.

Significant effect was detected for treatments applied on serum uric acid level. Feeding chicks diet containing 20% raw sunflower seeds resulted in a higher level (4.15 mg./100 ml.) of serum uric level at the 56th day of chick's age than did any other treatment applied.

On the other hand, insignificant variation was found in serum uric acid content between controls and those fed diet containing 10% raw sunflower seeds and 20% steam heated

seeds. Averages of serum uric acid in these groups were approximately the same and ranged from 3.65 to 3.67 mg./100 ml. The lower average of serum uric acid was found in chicks fed 10% sunflower meal (3.06 mg./100 ml.) followed by those fed 10% steam heated seeds (3.16 mg./100 ml.) (table 37).

Variation in serum uric acid content may be attributed to the variation in its elimination or to the variation occurred in protein metabolism in the bird, since uric acid is the end product in this aspect. In addition, the low solubility of uric acid in blood (about 10%) has long caused investigators to be puzzled as its mode of transport (Sturkie, 1965).

Serum level of createnine showed no similar trend as birds of different experimental groups grew older. It increased by age in some groups (in those fed diets containing 20% raw seeds, 10% steam heated seeds and 10% sunflower meal) while it decreased in the other groups.

At the 56th day of chick's age the higher level of serum createnine was found in chicks fed diet containing 20% raw sunflower seeds (1.86 mg./100 ml.), followed by those fed diet containing 10% steam heated seeds (1.77 mg./100 ml.), while it ranged from 1.59 to 1.61 mg./100 ml. in blood serum of the other experimental groups.

However, no significant variations were found in serum createnine content due to either treatments applied, bird's age or the interaction between them (ANOVA Table38). This may be attributed to the well known fact that the amount of createnine formed in birds is negligible in relation to the amount of creatin which may show insignificant response to the factors studied.

Okumura and Tasaki, (1969), found a wide fluctuations in serum uric acid levels, which had been associated with the protein content of the diet and the time of blood sampling relative to food intake.

On the other hand, Setchell, (1959) and (1961), noted that, severe kidney disfunction was indicated by the rise in plasma createnine.

Table 37: Average of serum uric acid and createnine content (in mg/100 ml.) for Arbor Acer broiler chicks fed diets containing raw and processed sunflower seeds.

Treatments	Average serum content X ± SE in mg/100 ml.			
	Uric acid		Createnine	
	7 days	56 days	7 days	56 days
Control group	4.27 ± 0.05	3.65 ± 0.08 c	1.64 ± 0.04	1.58 ± 0.03 a
Raw sunflower seeds 10%	4.19 ± 0.05	3.65 ± 0.21 c	1.61 ± 0.03	1.57 ± 0.07 a
Raw sunflower seeds 20%	4.25 ± 0.07	4.15 ± 0.05 a	1.63 ± 0.01	1.86 ± 0.05 a
Steam heated seeds 10%	4.24 ± 0.04	3.16 ± 0.04 c	1.62 ± 0.04	1.77 ± 0.11
Steam heated seeds 20%	4.31 ± 0.06	3.67 ± 0.12 b	1.64 ± 0.04	1.61 ± 0.14 a
Sunflower meal 10%	4.25 ± 0.05	3.06 ± 0.03 ac	1.60 ± 0.06	1.61 ± 0.09 a
Sunflower meal 20%	4.23 ± 0.04	3.83 ± 0.07 b	1.61 ± 0.04	1.59 ± 0.08 a

N.B., Means of the same column bearing different letters differed significantly.

Table38: ANOVA for data presented in Table(37)

S.O.V.	d.f	Mean Squares	
		Uric acid	Createnine
Bet. T.	6	0.2043 **	0.0211
Bet. A.	1	4.4623 **	0.0104
Bet. R.	2	0.0072	0.0040
(T X A)	6	0.2240 **	0.0184
Error	26	0.0210	0.0149

** Significant at level 0.01

4.2.5. Mortality rate:

- During the period of the first experiment no mortality cases occurred.
- During the period of the second experiment a number of 17 chicks died, showing a mortality rate of 7.69%.

Table 39: Pattern of mortality in various experimental groups during periods of applying both starting and finishing rations.

Experimental groups	Pattern of mortality, No. of chicks died during applying		
	Starting diets from snd-4th week	Finishing diets from 5th-8th week	Allover the exp. period from 2nd-8th week
Control group	--	4	4
Raw sunflower seeds 10%	--	1	1
Raw sunflower seeds 20%	--	--	--
Steam heated seeds 10%	--	2	2
Steam heated seeds 20%	1	3	4
Sunflower meal 10%	--	3	3
Sunflower meal 20%	--	3	3

* No. of chicks per experimental group was 30.