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EFFECT OF HIGH ENERGY DIET (USING 2% ULTRAKEAL®) ON BROILER PERFORMANCE, LITTER QUALITY AND IMMUNE RESPOSNE

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SUMMARY

Three thousands day old chicks (Cobb) were divided into two groups and reared identically. The first gorup (high energy treatment) was fed a starter diet (24% CP, 3300 Kcal/kg ME) then a grower diet (21% CP, 3100 Kcal/kg ME) followed by a finisher diet (19% CP, 3100 Kcal./kg ME). 2% Ultrakcal® was added to adjust these levels of energy. The second group (conventional energy control) was fed a prestarter diet (24% CP, 2900 Kcal/kg. ME) then a starter diet (21% CP, 2800 Kcal./kg ME) and a grower diet (19% CP, 2800 Kcal./kg ME). Body weight was significanlty higher in birds fed high energy diet and the feed conversion ratio was significantly lower than the control group. The litter of the high energy treatment maintained a stable pH throughout the experiment and optimum moisture content indicating good quality litter. The sustainability of the maternal immunity for both ND and IBD was not affected by the dietary treatment. The non specific immune response to SRBCs was significantly higher in birds fed high energy ration, also, the stimulation index of lymphocyte transformation was significantly increased as compared with those of the conventional energy treatment.

INTRODUCTION

Broiler chickens have traditionally been fed relatively high energy diets because, in addition to promoting efficient feed utilization, it is also assumed that this type of diet maximizes growth rate (Leeson and Summers, 1991). Animal fat or a blend of vegetable oil and animal fat is commonly added to poultry diets to reduce dustiness, lubricate pellet diets, increase the dietary energy and improve the utilization of metabolizable energy calories and protein.

Broilers receiving high energy diet had a lower feed conversion and feed intake than birds receiving normal energy level diet (Lytle and

Messing, 1976, Coon et al., 1981 and Lei and Van Beek, 1997). Similarly, broilers that were fed commercial hydrolyzed animal fat-vegetable oil blend gained more weight and had a lower feed: gain ratio than broilers fed no added fat or lower levels of fat (Brue and Latshaw, 1985).

Proper maintenance of poultry litter is an important management criterion to obtain maximum broiler production. Both the quantity and quality of fat in the diet may have a significant effect on broiler performance and litter quality (Fowler, 1990). Poor quality fat depresses body weight, and results in a low efficiency of feed utilisation and high ether extract levels in litter; this greasy litter causes burnt hocks when the litter moisture exceeds 46% (Bray and Lynn, 1986).

There is some evidence to suggest that dietary fats may influence the immune response (Johnston, 1988). The fatty acid composition of the sera and immune tissues of chickens reflected that of the fat source in diet (Fritsche et al., 1991 b). Moreover, feeding chicks an n-3 rich diet (7% menhaden fish oil) significantly enhanced antibody production and altered lymphocyte proliferation (Fritsche et al., 1991a). On the other hand Praharaj et al. (1997) showed that the differences in dietary energy and protein had no influence on the maturation of immune system of broiler as measured by response to SRBC and *E. coli* inoculation at 10 and 15 days of age respectively.

The present study was carried out to evalu[illegible] effect of feeding high energy diet (supple[illegible] with 2% Ultrakcal®) on broiler perfor[illegible] litter quality and immune response.

MATERIAL AND METHODS

I- Experimental birds and management:

Three thousands day old chicks (Cobb) divided into two equal groups and reared open sided house at the Faculty of Vet. Me[illegible] Cairo University. The birds were floor reare[illegible] 10cm thick layer of clean chopped wheat litter. The first group was assigned to th[illegible] energy treatment, while the second one wa[illegible] as control and received a conventional e[illegible] level diet. The high energy diet was obtain[illegible] supplementation of the conventional energ[illegible] with 2% Ultrakcal®. The latter is a mixt[illegible] vegetable oils and fatty acids. It contains poly-unsaturated fatty acids of which 20% li[illegible] acid. The metabolisable energy of Ultrakca[illegible] 6400 Kcal/kg. The feeding programm[illegible] illustrated in table (1).

The following vaccination programme adopted in drinking water:

Hitchner B1 at 10 and 35 days, La Sota [illegible] days, IBD at 14 and 24 days of age.

II- Performance: Average body weight

Table 1 :Feeding programme for the high energy and conventional energy groups

Age	Type of diet	High energy	Conventional energy
Day old _ 1 week	Starter	24% CP 3300 Kcal ME	24%CP 2900 Kcal Me
2-4 weeks	Grower	21%CP 3100Kcal ME	21% CP 2800 Kcal ME
5-6 weeks	Finisher	19% CP 3100 Kcal ME	19% CP 2800 Kcal ME

determined weekly by weighing a sample of 100 birds from each group. The feed consumption was recorded weekly and feed convertion ratio was estimated.

III- Examination of litter: Composite samples from surface and deep litter were collected weekly in clean polyethylene bags and examined for determination of:-

1- pH:- This was done electrochemically in a 1/10 dilution in distilled water.

2- Moisture content:- The moisture percent was calculated after drying 100gm sample to a constant weight at 110°C (Parsons and Baker, 1985).

3- Total colony count:- By plating 1 ml of the appropriate dilution of 1gm sample using standard plate count agar.

IV- Immunological studies:-

One hundred birds from each group were wing-marked and blood samples were collected from each group on days 1, 7 and 14 for measuring maternal antibodies levels against ND virus using haemagglutination inhibition test (Beard, 1980) and infectious bursal disease virus using agar gel precipitation test (Cullen and Wyeth,1975).

On the 15th day of age, 30 birds from each group were inoculated individually with one ml of 10% suspension of sheep red blood cells (SRBCs) as an antigenic stimulant (Gross, 1986). Blood samples were collected from the inoculated birds on days 3, 7, 14 and 21 post inoculation and the following tests were carried out:-

I- Haemagglutination tes:- To measure the antibody response to SRBCs.

2- Lymphocyte transformation test:- Using modification of the method described by Lucy (1974) and (1977) and Charles et al. (1978).

3- Glucose consumption test:- The blastogenic response of peripheral blood lymphocyte was measured through biochemical estimation of residual glucose in culture medium (Shimakura et al. , 1985).

RESULTS and DISCUSSION

It is noticed from data presented in Table (2) and Fig. (3 and 4) that chickens receiving the high energy diet had significantly higher average body weight from the beginning of the fourth week until the end of the sixth week of age (1007, 1372 and 1870g respectively), as compared to chickens fed on conventional energy diet (888.3, 1209.6 and 1560.3 g).

Also, the feed conversion ratio of the high energy group was significantly lower than that of the normal energy group during the fifth and sixth weeks of age (1.85 and 2 as compared to 2 and 2.2 respectively). These results agree with those of Brue and Latshaw (1985) as they reported more weight gain and lower FCR in broilers fed on high energy diet.

The obtained results (Table 3) revealed that birds fed on a high energy diet had higher litter moisture content on the third and fifth weeks (18.2 and 25.7%) compared to (10.9 and 15.4%) for the conventional energy group. However, these high levels of moisture are still within the optimum range of 10-30% (Fowler, 1990).

The litter pH (Fig. 5) of the high energy group ranged from 6.6 to 7 which indicated a stable pH throughout the experimnt, while for the normal energy group, the litter pH shifted rapidly to the alkaline side (8.5, 9.8 and 9.5 in the 2nd , 3rd and 4th weeks respectivley). The high pH levels may be attributed to litter deterioration and high ammonia levels (Butcher and Miles, 1995).

On the other hand, litter from the hig group had higher values of total colony c compared to that of the normal energy gro significant increase in the microbial conte litter may be related to the stable pH a moisture levels.

It could be concluded that dietary factors high energy level can affect the litter qua these results agree to some extent wi published by Bray and Lynn (1986) who that the low energy/high protein diets led capped litter and severe hock burns.

Resutls in tables (4 and 5) show that scree the maternal antibodies for both ND a viruses on 1st, 7th and 14th days, reve significant differences between hig conventional energy treatment. On the co the non specific immune response to S (Table 6 and Fig. 1) revealed significantly HA antibodies in chickens fed high energy (2.5, 3.3 and 4.25) as compared with thos conventional energy group (1.9, 2.85 a when determined on 7, 14 and 21 day inoculation. These results disagree observations cited by Praharaj et al. (199 this could be attributed to the differences level of ME used (3146 Kcal/kg compare 3300 Kcal./kg in the present study) and the of SRBCs inoculation (10 days compared days in the present study). Also, in the p study, the commercial oil blend (Ultrakcal used to raise the ME level.

The illustrated results of (Table 7 and Fig. showing that the stimulation index of lymph

Table (2) : Effect of high energy diet on the performance of broiler chickens.

Age (Weeks)	Conventional diet		High energy diet	
	Body weight (g)	FCR•	Body weight (g)	FCR•
1	107.4	1.16	133.9	1.16
2	247.3	1.4	282.4	1.35
3	452.7	1.65	580	1.55
4	888.3	1.85	1007*	1.75
5	1209.6	2	1372*	1.85*
6	1560.3	2.2	1870*	2*

** significant differences P≤ 0.05*
•Feed conversion ratio

Table (3) : Effect of high energy diet on litter quality

Age (Weeks)	Conventional diet			High energy diet		
	Moisture %	pH	T.C.C.•	Moisture %	pH	T.C.C.•
1	10.3	6.6	4.7	10	6.6	4.7
2	7.1	8.5	6.9	8.8	7*	7.8*
3	10.9	9.8	6.9	18.2*	7*	8.3*
4	12.5	9.5	8.5	10.2	6.8*	8.3
5	15.4	7	8.4	25.7*	7	9.2*
6	26.4	7	9.1	27	7	9.5

** significant differences P≤ 0.05*
•log Total colony count

Table (4) Effect of high energy diet on maternal antibodies against Newcastle disease virus.

Age of testing	Arithmetic mean of HI test	
	Conventional diet	High energy diet
Day old	3.6	3.6
7 days	2.86	2.9
14 days	3.08	3.05

Table (5) Effect of high energy diet on maternal antibodies against Infectious bursal disease virus

Age of testing	% of positives AGPT*	
	Conventional diet	High energy diet
Day old	90%	90%
7 days	60%	80%
14 days	50%	60%

* Agar gel precipitation test

Table (6) Effect of high energy diet on haemagglutinin antibody response (GMT•) of chickens innoculated with sheep red blood cells.

Days post inoculation with sheep RBCs.	Conventional diet	High energy diet	Control
3 days	0	0	0
7 days	1.9	2.5*	0
14 days	2.85	3.3*	0
21 days	3.5	4.25*	0

•Geometric mean titer

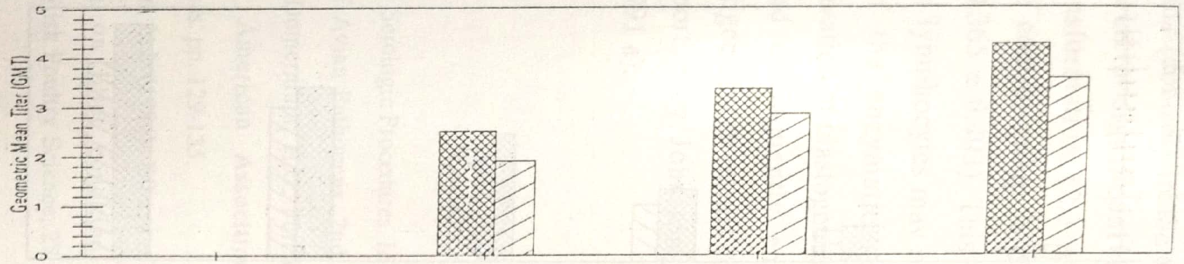
* significant differences P≤ 0.05

Table (7): Effect of high energy diet on lymphocyte transformation in chickens as judged by stimulation index using glucose consumption assay.

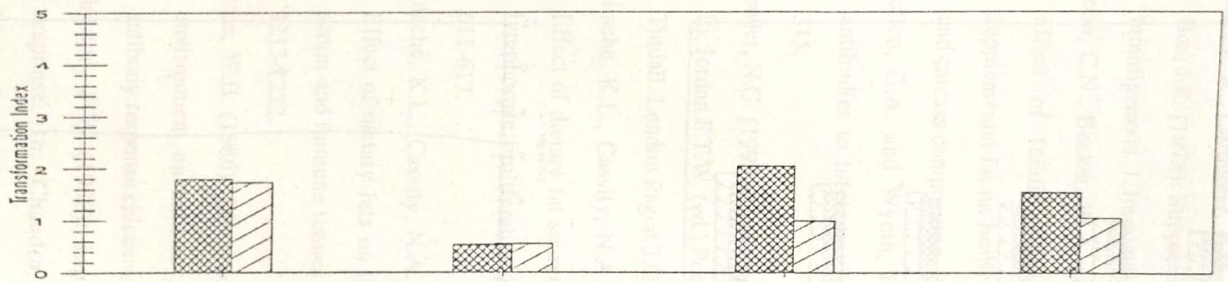
Days post Inoculation with sheep RBCSýs.	Stimulation index of lymphocytes of chickens ± SD			
	Conventional diet		High energy diet	
	Inoculated with Sheep RBCs.	Control	Inoculated with sheep RBCs.	Control
3 days	1.723±1.44	0.56±0.445	1.791±0.691	0.42±0.08
7 days	0.553±0.225	1.596±0.303	0.532±0.465	2.145±2.347
14 days	1.003±0.162	0.846±1.118	2.05±1.53*	0.636±0.51
21 days	1.06±0.312	0.365±0.403	1.55±0.966*	2.3±0.733*

* *significant differences P≤0.05*

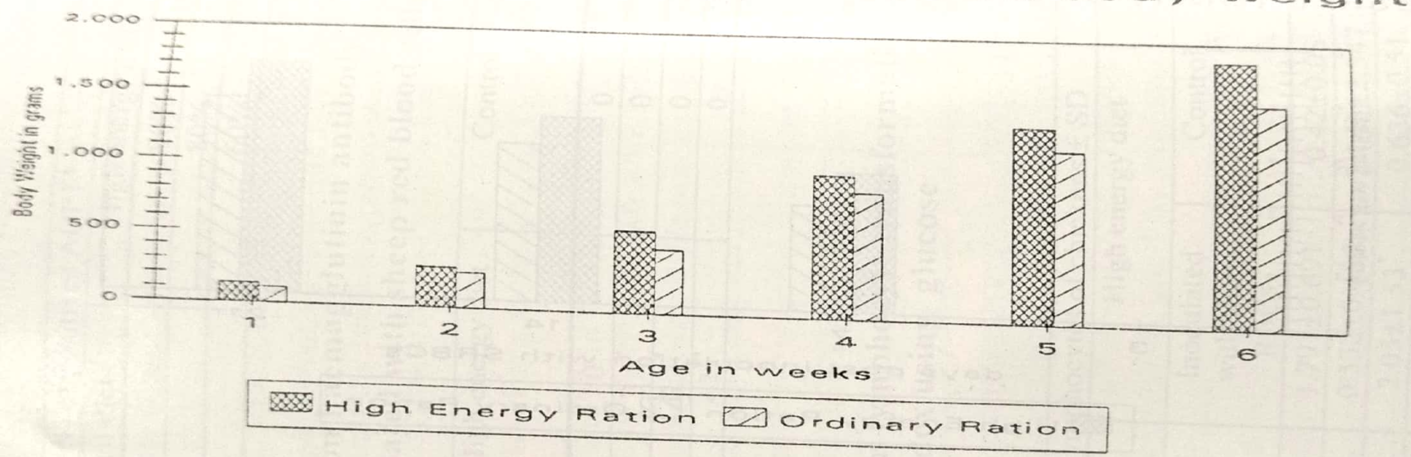
Fig.(1) Effect of high energy ration on haemagglutinin antibody response (GMT) of chickens immunized with sheep red blood cells



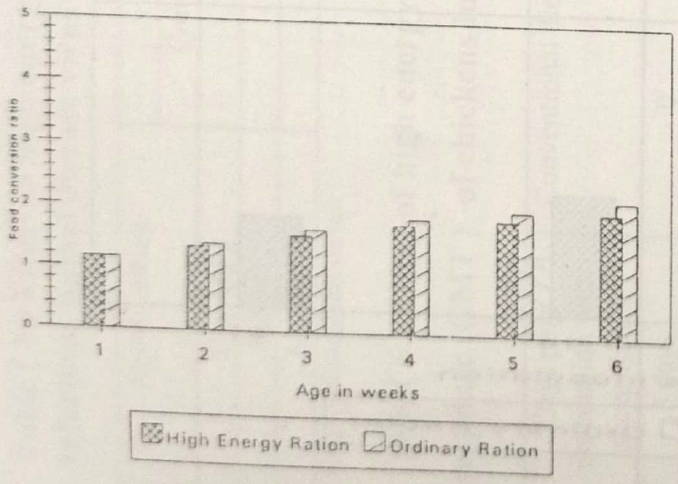
Fig(2). Effect of high energy ration on lymphocyte transformation in chickens as judged by stimulation index using glucose consumption assay.



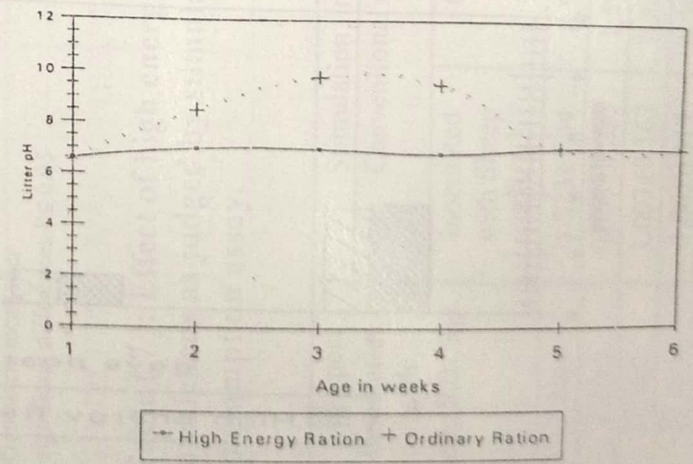
Fig(3). Effect of high energy ration on body weight



Fig(4). Effect of high energy ration on feed conversion ratio



Fig(5). Effect of high energy ration on litter pH



transformation was significantly increased in chickens fed the high energy diet at the 14th and 21st days post inoculation with SRBCs (2.05 ± 1.53 and 1.55± 0.966 as compared with 1.003 ± 0.162 and 1.06 ± 0.312 for the conventional energy gorup diet; respectively). Similarly, the uninoculated birds (control) in the high energy treatment, showed a significant increase in lymphocyte transformation (2.3 ± 0.733) as compared to the control group in conventional diet treatment (0.365 ± 0.403). This increase in transformation of lymphocytes may be due to the enhancement of the enzymatic activity that promotes the activation of blastogenesis inside the lymphocytes and consequently enhances the processing of antigen. These results coincide with the findings reported by Johnston (1988) and Fritsche et al. (1991 a).

REFERENCES

Beard, C.W. (1980): Serologic Procedures. In: Isolation and Identification of Avian Pathogens, 2nd edition. S.B., Hitchner, C.H. Domermuth, H.G. Purchase, and J.K. Wiliams, eds. American Association of Avian pathologists. Texas. pp. 129-135.

Bray, T.S. and Lynn, N.J. (1986): Effects of nutrition and drinker design on litter condition and broiler performance. British Poultry Science, 27 (1) abst. page 151.

Brue, R.N. and Latshaw, J.D. (1985): Energy utilizaiton by the broiler chicken as affected by various fats and fat levels. Poultry Sci. 64 (11): 2119-2130.

Butcher, G.D. and Miles, R.D. (1995): Causes and prevention of wet litter in broiler houses. Fact Sheet VM99 of the College of Veterinary Medicine, Florida Cooperative Extension Service, Instiute of Food and Agricultural Sciences, Univeristy of Florida, Gainesbille FL 3261.

Charles, R., Carpenter, A.B, Henry, R. and Bos, J.R. and Bos, J.R. (1978): Suppression of the mitogen-stimulated tumorigenesis. J. Immunol., 120 (4): 1313-1320.

Coon, C.N., Becker, W.A. and Spencer, J.V. (1981): The effect of feeding high energy diets containing supplemental fat on broiler weight gain, feed efficiency and carcass composition. Poultry Sci, 60: 1264-1271.

Cullen, G.A. and Wyeth, P.J. (1975): Quantitation of antibodies to infectious bursal disease. Vet. Rec. 97: 315.

Fowler, N.G. (1990): How to carry out a field investigation. In: Jordan F.T.W. (ed.) Poultry Diseases 3rd ed. Bailleire Tindall. London Paged 372-400.

Fritsche, K.L., Cassity, N.A. and Huang, S.C. (1991 a): Effect of dietary fat source on antibody production and lymphocyte proliferation in chickens. Poultry sci. 70: 611-617.

Fritsche, K.L., Cassity, N.A. and Huang, S.C. (1991 b): Effect of dietary fats on the fatty acid composition of serum and immune tissues in chickens. Poultry Sci. 70: 1213-1222.

Gross, W.B. (1986): Effect of dose of antigen and social environment on antibody response of high and low antibody response chickens. Poultry Sci. 65: 687-692.

Johnston, P.V. (1988): Lipid modulation of immune response. In: Chandra, R.K. ed. Nutrition and Immunology. Alan R. Liss, Inc, New York Pages 37-86.

Leeson, S. and Summers, J.D. (1991): Broiler diet specification. In: Commercial Poultry Nutrition. University Books. Guelph, Ontario, Canada.

Lei. S. and Van Beek, G. (1997): Influence of activity and dietary energy on broiler performance, carcass yield and sensory quality. British Poultry Sci., 38 (2): 183-189.

Lucy, F.L. (1974): In vitro assay of mitogen stimulation of avian peripheral lymphocytes. Avian Diseases, 18: 602-608.

Lucy, F.L. (1977): Chicken lymphocyte stimulation by mitogen: a microassay with whole blood cultures. Avian Diseases, 22 (2): 296-307.

Lytle, L.D. and Messing, R.B. (1976): Appetite in the regulation of food intake for energy (animal and man). Progress in Food and Nutrition Science, 2: 49-58.

Parsons, A.H. and Baker, S.L. (1985): Softwoo fines: efficacy as poultry litter. Poultry 2292-2295.

Praharaj, N.K., Dunnington, E.A. Gross, W.B. P.B. (1977): Dietery effects on immune respo growing chicks to inoculation of sheep eryth Escherichia coil. Poultry Sci., 76: 244-247.

Shimakura, Y., Kuds, T., Hongo, H. and Ki (1985): Glucose consumption test for transformation in "Shiba" goat. Res. Bull. Gifu. Univ. Japan. 50: 324-334.