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EFFECT OF DIFFERENT LEVELS OF METABOLIZABLE ENERGY AND FAT ON BROILER CHICK PERFORMANCE UNDER HEAT STRESS CONDITIONS.

Ghazalah, A. A . and M .O . Abd – Elsamee
Department of Animal Production, Fac. of Agriculture, Cairo University.

ABSTRACT

A total number of 675 one – day old unsexed Arbor Acres broiler chicks were used to study the effect of dietary metabolizable energy (ME) and poultry fat (PF) on broiler chick performance, nutrients digestibility coefficient and economic efficiency during hot summer season. Birds were randomly divided into 9 equal groups with three replicates of 25 birds each .Three levels of metabolizable energy were used , being 3000 (low level) , 3100 (recommended level) and 3200 K cal ME / Kg (high level) for growing period (1– 4 weeks of age) with constant crude protein level (23 %) .While, for finishing period (5 – 7 weeks of age) at 20 % crude protein , 3100 (low level) , 3200 (recommended level) and 3300 Kcal ME / Kg (high level).Each level of metabolizable energy was supplemented with three levels of poultry fat in a 3 x 3 factorial arrangement to alleviate the side effects of heat stress (29–36 °C) on broiler performance .The three levels of poultry fat were 0,3 and 6% of the diet representing PF1,PF2 and PF3, respectively. The birds were allocated in a littered floor poultry house in an open system under the same conditions of management up to 7 weeks of age .

The overall results showed that the average values of body weight (BW) , body weight gain (BWG), feed conversion ratio (FCR) and performance index (PI) were improved significantly ($P < 0.05$) with high level of either metabolizable energy or poultry fat especially during the finishing period . Data showed that only the digestibility coefficient for both crude protein (CP) and ether extract (EE) were improved significantly ($P < 0.05$) when broiler chicks were fed diets containing high level of either metabolizable energy or poultry fat .Results indicated that the average values of abdominal fat increased significantly ($P < 0.05$) with using high level of either metabolizable energy or poultry fat .While, there were no significant differences for both dressing, giblets and mortality rate values due to dietary treatments .Data also indicated that using high level of either metabolizable energy or poultry fat recorded higher values for economic efficiency compared with other experimental groups .

Therefore , it is suggested to increase dietary metabolizable energy more than recommended level during both growing and finishing periods when adding fat up to 6 % of the diet to alleviate the side effects of heat stress on the performance of broilers .
Keywords : Heat stress , broiler performance , metabolizable energy , poultry fat

INTRODUCTION

Hot climate is a major limiting factor for broiler production in tropical and subtropical regions such as Egypt . Broilers have a very poor heat tolerance, especially with more rapidly growth. Arjona *et al* . (1988) and Osman (2000) indicated that as environmental temperature exceeds 35 ° C , morbidity and mortality of broilers increased substantially . Increasing ambient temperature above 30 °C from 4 weeks of age up to marketing age reduced growth performance as a result of decreasing feed intake , growth rate and feed utilization of broilers (Cerniglia *et al* ., 1983 ; Sinurat and Balnave ,1985 ; Meltzer, 1987; Cahaner and Leenstra, 1992; Teeter, 1995 ; Hussein , 1996 ; Cooper and Washbrun , 1998 ; Yalcin *et al* .; 1998 ; 2001; and Al – Harthi *et al* ., 2002).Also, exposure of chickens to heat stress (32 ° C) tends to reduce digestibility coefficients of nutrients as a result of decreasing blood flow to the digestive system . This would reduce proteolytic enzymatic activities (Wallis and Balnave, 1984 ; Belay *et al* ., 1993 ; Zuprizal et al ., 1993 ; and Bonnet *et al*., 1997). In order to overcome the adverse effect of heat stress, a considerable amount of research has been conducted depending upon nutritional conditions such as increasing metabolizable energy according to Dale and Fuller (1980); Deaton *et al.* (1984); Howlider and Rose (1987); Nagra and Sethi (1993); and Al – Harthi *et al.* (2002) who showed that growth rate and efficiency of feed utilization were increased significantly with increasing dietary metabolizable energy. While, Baghel and Pradhan (1989, 1990); and Hoffmann *et al.* (1991) referred to decrease the dietary metabolizable energy under hot conditions. The addition of fat is another attempt to alleviate the side effects of heat stress on broiler performance due to the decrease in heat increment of fat (Dale and Fuller , 1980 ; and Deaton *et al* .,1984). While, Sinurat and Balnave (1985) ; and Soliman *et al* . (1999) did not find beneficial effect on broiler performance due to adding high levels of fat or oil to broiler chick diets under hot conditions .

Due to these conflicting results , this work was conducted to define the best combination of metabolizable energy and fat levels required for the optimum growth performance of broiler chicks under hot summer season .

MATERIALS AND METHODS

This work was conducted at the Department of Animal Production , Faculty of Agriculture , Cairo University, during July and August , 2001 . The analytical part of study was performed at the Laboratories of the same Department. A total number of 675 one – day old unsexed Arbor Acres broiler chicks of nearly similar live body weight (40 g) were used to study the effect of different levels of metabolizable energy (ME) and poultry fat (PF) on broiler performance , nutrients digestibility coefficient , carcass characteristics and economic efficiency .The birds were randomly distributed into 9 treatments , each contained 75 birds in three replicates of 25 birds each . All diets were formulated by using linear programming to contain the tested levels of metabolizable energy and poultry fat . Three levels of metabolizable energy and three levels of poultry fat were tested in 3 x 3 factorial design to alleviate the side effects of heat stress. Metabolizable energy levels were 3000 (low level) , 3100 (recommended level) and 3200 K cal ME / Kg (high level) for growing period (1– 4 weeks of age) and 3100 (low level) , 3200 (recommended level) and 3300 K cal ME / Kg (high level) for finishing period (5 – 7 weeks of age) .The three levels of poultry fat were 0 % (PF1) , 3 % (PF2) and 6 % (PF3) for each level of metabolizable energy during both growing and finishing periods as shown in Tables 1 and 2. In all experimental diets, minerals and vitamins were adjusted according to the strain recommended catalog . All diets were isonitrogenous (23 % at growing and 20 % at finishing period) and fed in mash form . Chicks were allocated in a littered floor poultry house in an open system under the same management conditions. Water and feed were offered *ad – libitum* and artificial lighting was provided 24 hours daily allover the experimental period, which lasted for 7 weeks. The minimum and maximum ambient temperature were recorded daily at noon (12 p.m) . The ambient temperature ranged between 29 and 36 °C during the experimental period (1 – 7 weeks of age). Live body weights and feed consumption were recorded weekly; besides, records of daily mortality were obtained .The performance index (live body weight (Kg) X 100 / feed conversion ratio) was calculated according to North (1981) . At 49 days of age , 6 birds (3 males and 3 females) of each treatment were randomly taken and housed in individual cages to determine the digestibility coefficient of nutrients, thereafter, these birds were used to study the carcass characteristics .

Table (1) : Composition and calculated analysis of experimental grower diets (1 – 4 weeks) .

Ingredients	3000 Kcal ME / Kg			3100 Kcal ME / Kg			3200 Kcal ME / Kg		
	0%	3%	6%	0%	3%	6%	0%	3%	6%
Yellow corn	57.0	50.0	41.0	61.6	55.0	45.5	66.2	59.0	50.0
Soybean meal (44 %)	7.5	20.7	26.0	8.5	21.6	27.0	9.0	20.6	26.8
Corn gluten (60 %)	16.0	8.0	4.6	16.0	8.0	4.6	16.2	9.0	5.1
Wheat bran	11.9	10.9	15.1	6.3	5.0	9.6	1.0	1.0	4.8
Fish meal (72 %)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Poultry fat	-	3.0	6.0	-	3.0	6.0	-	3.0	6.0
Bone meal	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Limestone	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Na Cl	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Vit . & Min . Premix*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Dl – methionine	-	0.1	0.1	-	0.1	0.1	-	0.1	0.1
L - lysine HCl	0.4	0.1	-	0.4	0.1	-	0.4	0.1	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis**									
CP %	23	23	23	23	23	23	23	23	23
ME Kcal / Kg	3000	3000	3000	3100	3100	3100	3200	3200	3200
C / P ratio	130	130	130	135	135	135	140	140	140
EE %	3.10	5.84	8.49	3.30	6.04	8.65	3.45	6.21	8.85
CF %	3.45	3.99	4.58	3.00	3.52	4.14	2.56	3.12	3.78
Ca %	0.95	0.98	0.99	0.94	0.98	0.99	0.94	0.97	0.99
Avail . P %	0.47	0.47	0.48	0.45	0.46	0.47	0.44	0.48	0.49
Meth . %	0.58	0.59	0.55	0.58	0.59	0.56	0.58	0.59	0.56
Lys . %	1.20	1.24	1.22	1.20	1.20	1.23	1.20	1.20	1.22
Meth. + Cys. %	0.95	0.95	0.91	0.95	0.95	0.92	0.95	0.95	0.92
Price / ton (LE)	1110	1090	1075	1130	1107	1095	1145	1120	1080

* Vitamin and mineral premix at 0.3 % of the diet supplies the following per Kg of the diet: Vit. A 12000 IU, Vit. D_3 3500 IU, Vit. E 30 mg , Vit. K_3 3 mg , Vit. B_1 3 mg , Vit. B_2 8 mg , Pantothenic acid 12 mg , Folic acid 1 mg , Biotin 5 mcg , Choline chloride 600 mg , Niacin 66 mg , Vit. B_6 5 mg , Vit. B_{12} 20 mcg , Mn 100 mg , Fe 100 mg , Zn 75 mg , Cu 8 mg , I 45 mcg and Se 10 mcg .

** According to NRC (1994)

Table (2) : Composition and calculated analysis of experimental finisher diets (5 – 7 weeks) .

Ingredients	3100 Kcal ME / Kg			3200 Kcal ME / Kg			3300 Kcal ME / Kg		
	0%	3%	6%	0%	3%	6%	0%	3%	6%
Yellow corn	65.3	58.0	49.2	69.6	62.5	54.0	73.6	66.0	57.4
Soybean meal (44 %)	3.0	16.0	22.8	3.5	17.0	23.5	2.0	14.0	21.0
Corn gluten (60 %)	17.8	10.0	6.0	18.0	10.0	6.0	19.5	12.3	8.0
Wheat bran	10.0	9.3	12.5	5.0	3.8	7.0	1.0	1.0	4.0
Poultry fat	-	3.0	6.0	-	3.0	6.0	-	3.0	6.0
Bone meal	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Limestone	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Na Cl	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Vit . & Min . Premix*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Dl – methionine	-	0.1	0.1	-	0.1	0.1	-	0.1	0.1
L - lysine HCl	0.6	0.3	0.1	0.6	0.3	0.1	0.6	0.3	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis**									
CP %	20	20	20	20	20	20	20	20	20
ME Kcal / Kg	3100	3100	3100	3200	3200	3200	3300	3300	3300
C / P ratio	155	155	155	160	160	160	165	165	165
EE %	3.00	5.73	8.39	3.18	5.92	8.59	3.35	6.10	8.73
CF %	3.11	3.67	4.24	2.69	3.22	3.79	2.26	2.83	3.39
Ca %	0.86	0.89	0.92	0.86	0.89	0.91	0.85	0.88	0.90
Avail . P %	0.42	0.43	0.44	0.40	0.41	0.43	0.40	0.41	0.42
Meth . %	0.51	0.52	0.49	0.52	0.53	0.50	0.53	0.55	0.51
Lys . %	1.05	1.05	1.02	1.05	1.06	1.01	1.01	1.00	1.04
Meth. + Cys. %	0.85	0.85	0.81	0.85	0.86	0.83	0.87	0.88	0.84
Price / ton (LE)	1010	985	960	1020	1000	980	1040	1020	1000

* Vitamin and mineral premix at 0.3 % of the diet supplies the following per Kg of the diet: Vit. A 12000 IU, Vit. D_3 3500 IU, Vit. E 30 mg , Vit. K_3 3 mg , Vit. B_1 3 mg , Vit. B_2 8 mg , Pantothenic acid 12 mg , Folic acid 1 mg , Biotin 5 mcg , Choline chloride 600 mg , Niacin 66 mg , Vit. B_6 5 mg , Vit. B_{12} 20 mcg , Mn 100 mg , Fe 100 mg , Zn 75 mg , Cu 8 mg , I 45 mcg and Se 10 mcg .

** According to NRC (1994) .

The assigned birds were individually weighed, slaughtered to complete bleeding, followed by feathers plucking. Weights of dressing , giblets and abdominal fat were expressed relative to live body weight.The analysis of feed and dried excreta were done according to A.O.A.C. (1990). Fecal nitrogen was determined according to Jakobson *et al.* (1960). Nitrogen – free extract was calculated according to Abou – Raya and Galal (1971). The economic efficiency of the product was calculated from the money out put–money input analysis and represented as the total cost needed to obtain one kilogram body weight and the net revenue per unit of total costs under local conditions. The data obtained were examined statistically by using MSTAT–C(1989) procedure. Differences among treatment means were separated by Duncan's new multiple – range test (Duncan, 1955) . Significance was defined as $P < 0.05$.

RESULTS AND DISCUSSIONS

Broiler performance :

Growing period (1 – 4 weeks of age) :

The effects of dietary metabolizable energy (ME) and poultry fat (PF) and their interaction on broiler performance during the growing period (1 – 4 weeks of age) are presented in Table 3 . Data showed that when broiler chicks were fed diets containing high level of metabolizable energy (ME3) , the average values of body weight (BW) , body weight gain (BWG) , feed conversion ratio (FCR) and performance index (PI) were improved significantly ($P < 0.05$) compared with those fed diets containing low level of metabolizable energy (ME1) . While no significant differences were detected in broiler performance parameters between broilers fed high level of metabolizable energy (ME3) and those having recommended level of metabolizable energy (ME2) . Also , feed intake was not affected significantly ($P < 0.05$) by different levels of metabolizable energy . Results showed that when broiler chicks were fed diets containing high level of fat , 6 % of the diet (PF3), the average values of body weight, body weight gain and performance index were also improved significantly ($P < 0.05$) comparing to those fed diets containing either low level of fat being 3 % (PF2) or no supplemented fat (PF1) .

Table (3) : Effect of dietary treatments on broiler performance during the growing period (1-4 weeks of age).

Treatments			B.W (g)	B.W.G (g)	F.I (g)	F.C.R	P.I
No .	ME	PF					
	ME1	-	874^{b}	834^{b}	1661^{a}	1.99^{a}	43.9^{c}
	ME2	-	878^{ab}	838^{ab}	1612^{a}	1.92^{b}	45.7^{b}
	ME3	-	895^{a}	855^{a}	1628^{a}	1.90^{b}	47.1^{a}
	-	PF1	876^{b}	836^{b}	1635^{a}	1.95^{a}	44.9^{b}
	-	PF2	872^{b}	832^{b}	1619^{a}	1.95^{a}	44.7^{b}
	-	PF3	899^{a}	859^{a}	1647^{a}	1.92^{a}	46.8^{a}
1	ME1	PF1	875^{bcd}	835^{bcd}	1670^{a}	2.00^{a}	43.7^{ef}
2	ME1	PF2	897^{cd}	827^{cd}	1654^{a}	1.99^{a}	43.4^{f}
3	ME1	PF3	880^{bcd}	840^{bcd}	1660^{a}	1.97^{ab}	44.5^{def}
4	ME2	PF1	877^{bcd}	837^{bcd}	1620^{bc}	1.93^{bc}	45.3^{cd}
5	ME2	PF2	865^{d}	825^{d}	1591^{c}	1.93^{bc}	44.8^{de}
6	ME2	PF3	892^{b}	852^{b}	1624^{b}	1.90^{cd}	46.9^{b}
7	ME3	PF1	875^{bcd}	835^{bcd}	1614^{bc}	1.93^{bc}	45.3^{cd}
8	ME3	PF2	885^{bc}	845^{bc}	1613^{bc}	1.91^{cd}	46.3^{bc}
9	ME3	PF3	925^{a}	885^{a}	1658^{a}	1.87^{d}	49.4^{a}
L . S . D			17	17	28	0.05	0.05

B.W = Body weight (g) B.W.G = Body weight gain (g) F.I = Feed intake (g)

F.C.R = Feed conversion ratio P.I = Performance index

a , b , c ... Means in each column, within each item, bearing the same superscripts are not significantly different ($P < 0.05$).

However , no significant differences were observed in average values of feed intake and feed conversion ratio due to using different levels of poultry fat.The interaction effect of metabolizable energy and poultry fat on broiler performance during the growing period is presented in Table 3 . Results showed that feeding broiler chicks diets containing high level of metabolizable energy (ME3) and high level of poultry fat (PF3) recorded significantly ($P < 0.05$) the best values of broiler performance parameters compared with other treatments .

Finishing period (5 – 7 weeks of age) :

The effect of dietary treatments on broiler performance during the finishing period (5 – 7 weeks of age) is presented in Table 4 . Results showed that the average values of broiler chicks performance were improved significantly ($P < 0.05$) when broiler chicks were fed diets containing high level of metabolizable energy (ME3) compared with those fed diets containing either recommended metabolizable energy level (ME2) or low level of metabolizable energy (ME1) . While , when broiler chicks were fed diets containing low level of metabolizable energy (ME1) the average values of broiler chicks performance were decreased significantly ($P < 0.05$). These results were confirmed by Howlider and Rose (1987); Nagra and Sethi (1993) and Al – Harthi *et al* . (2002) who indicated that broiler performance increased significantly with increasing dietary metabolizable energy. On the contrary to our findings ,Baghel and Pradhan (1989 , 1990) and Hoffmann *et al* . (1991) found that dietary metabolizable energy must be decreased when broiler chicks were reared under heat stress . They indicated that the total amounts of metabolizable energy used for maintenance and growth were maximum in the cold season followed by that in hot season . Data in Table 4 showed that when broiler chicks were fed diets containing 6 % poultry fat (PF3) the average values of broiler performance were improved significantly ($P < 0.05$) comparing to other levels of added poultry fat . This could be attributed to improving the diet palatability and increasing the amounts of feed intake due to adding poultry fat to broiler chick diets.The beneficial effect of high fat diets on heat stressed chicks results largely from the associative dynamic effect of such diets .There is now sufficient evidence to show that the associative dynamic effect , originally attributed simply to a decrease in heat increment when dietary mixtures contained fat . The same results were obtained by Dale and fuller (1980) and Deaton *et al* . (1984) who found that broiler chicks which received high dietary fat gained more weight than those fed low dietary fat level, when broiler chicks fed diets containing dietary fat levels ranged between 2.5 and 10 % under heat stress (22 – 35 ^{o}C) conditions. On the contrary to these results , Sinurat and Balnave (1985) and Soliman *et al* . (1999) fed broiler chicks on diets containing different levels of either fat or oil under heat stress and did not find any improvement in broiler performance . Results in Table 4 showed also the interaction effect of dietary metabolizable energy X poultry fat on broiler performance during the finishing period . Data showed that the best values were recorded when broiler chicks were fed diet containing high level of metabolizable energy (E3) through the addition of high level of poultry fat (PF3) . While , the worst values were recorded when broiler chicks were fed on the diet which contained low level of metabolizable energy (ME1) without poultry fat supplementation (PF1) .

Table (4) : Effect of dietary treatments on broiler performance during the finishing period (5- 7 weeks of age).

Treatments			B.W	B.W.G	F.I	F.C.R	P.I
No .	ME	PF	(g)	(g)	(g)		
	ME1	-	1680^{c}	805^{c}	2019^{b}	2.51^{a}	66.9^{c}
	ME2	-	1781^{b}	902^{b}	2121^{a}	2.35^{b}	75.8^{b}
	ME3	-	1824^{a}	925^{a}	2118^{a}	2.29^{c}	79.6^{a}
	-	PF1	1720^{c}	844^{c}	2061^{b}	2.44^{a}	70.5^{c}
	-	PF2	1753^{b}	876^{b}	2079^{b}	2.37^{b}	73.9^{b}
	-	PF3	1812^{a}	912^{a}	2116^{a}	2.32^{b}	78.1^{a}
1	ME1	PF1	1650^{e}	775^{e}	2000^{e}	2.58^{a}	63.9^{h}
2	ME1	PF2	1683^{d}	815^{d}	2033^{de}	2.49^{b}	67.4^{g}
3	ME1	PF3	1705^{d}	825^{d}	2023^{de}	2.45^{bc}	69.5^{f}
4	ME2	PF1	1753^{c}	875^{c}	2115^{bc}	2.41^{c}	72.6^{e}
5	ME2	PF2	1760^{c}	895^{c}	2098^{bc}	2.34^{d}	75.1^{d}
6	ME2	PF3	1830^{b}	937^{b}	2150^{ab}	2.29^{d}	79.8^{b}
7	ME3	PF1	1758^{c}	882^{c}	2069^{cd}	2.34^{d}	75.1^{d}
8	ME3	PF2	1815^{b}	917^{b}	2108^{bc}	2.32^{d}	78.0^{c}
9	ME3	PF3	1900^{a}	975^{a}	2176^{a}	2.23^{e}	85.1^{a}
L . S . D			26	22	57	0.05	0.6

a , b , c ... Means in each column, within each item, bearing the same superscripts are not significantly different ($P < 0.05$).

Digestibility coefficients :

The effects of dietary metabolizable energy (ME) and poultry fat (PF) and their interaction on nutrients digestibility coefficients of the finisher experimental diets are presented in Table 5. Results showed that the average values for digestibility coefficients of crude protein (CP) and ether extract (EE) were significantly ($P < 0.05$) increased with using high level of metabolizable energy (ME3) compared with either low level (ME1) or recommended level (ME2). Moreover , the average value of ether extract (EE) digestibility was significantly ($P < 0.05$) increased with using high level of poultry fat (PF3) comparing to either low level (PF2) or without poultry fat supplementation (PF1). Data showed that the average values of digestion coefficients were nearly similar and there was no clear trend due to the interaction between dietary levels of metabolizable energy (ME) and poultry fat (PF) .

Carcass characteristics :

The effects of dietary treatments on carcass characteristics (dressing , giblets and abdominal fat %) are shown in Table 6. There were no significant differences ($P < 0.05$) in average values for dressing and giblets due to using different levels of either metabolizable energy or poultry fat. While , when broiler chicks were fed diets containing high level of either metabolizable energy (ME3) or poultry fat (PF3) , the average values of abdominal fat were increased significantly ($P < 0.05$) compared with other levels of metabolizable energy and poultry fat . Similar results were obtained by Soliman *et al* .(1999) and Al – Harthi *et al* .(2002) who found that the average values of abdominal fat were increased significantly with increasing dietary metabolizable energy under heat stress conditions .

Table (5) : Effect of dietary treatments on the digestibility coefficients (%) of the experimental finisher diets .

Treatments			OM	CP	EE	CF	NFE
No .	ME	PF					
	ME1	-	70.6^{b}	82.5^{b}	78.2^{b}	22.3^{a}	72.1^{a}
	ME2	-	71.2^{a}	82.4^{b}	77.6^{b}	22.7^{a}	71.8a
	ME3	-	71.4^{a}	83.1^{a}	80.4^{a}	22.8^{a}	71.7a
	-	PF1	69.6^{b}	81.9^{b}	69.2^{c}	22.4^{a}	71.7^{a}
	-	PF2	71.5^{a}	82.8^{a}	80.9^{b}	22.3^{a}	71.9^{a}
	-	PF3	72.1^{a}	83.2^{a}	86.2^{a}	23.1^{a}	71.9^{a}
1	ME1	PF1	68.6^{e}	81.8^{ef}	67.9^{f}	21.9^{a}	71.7^{a}
2	ME1	PF2	71.1^{c}	82.5^{cd}	80.8^{cd}	21.7^{a}	72.6^{a}
3	ME1	PF3	72.0^{ab}	83.1^{ab}	85.9^{b}	23.3^{a}	72.1^{a}
4	ME2	PF1	70.2^{d}	81.6^{f}	68.1^{f}	22.8^{a}	71.8^{a}
5	ME2	PF2	71.5^{bc}	82.8^{bc}	79.9^{d}	22.3^{a}	71.2^{a}
6	ME2	PF3	71.9^{ab}	82.9^{bc}	84.9^{b}	22.9^{a}	72.3^{a}
7	ME3	PF1	96.9^{d}	82.3^{de}	71.6^{e}	22.6^{a}	71.6^{a}
8	ME3	PF2	71.9^{ab}	83.3^{ab}	81.9^{c}	22.9^{a}	72.0^{a}
9	ME3	PF3	72.5^{a}	83.7^{a}	87.8^{a}	23.0^{a}	71.5^{a}
L . S . D			0.6	0.5	1.2	1.8	1.5

a , b , c ... Means in each column, within each item, bearing the same superscripts are not significantly different ($P < 0.05$).

Table (6) : Effect of dietary treatments on carcass characteristics and mortality rate .

Treatments			Dressing (%)	Giblets (%)	Abdominal fat (%)	Mortality rate	
No .	ME	PF				No .	%
	ME1	-	62.1^{a}	5.97^{a}	3.44^{b}	3^{a}	12.0^{a}
	ME2	-	62.0^{a}	5.95^{a}	3.52^{b}	3^{a}	12.0^{a}
	ME3	-	62.1^{a}	5.96^{a}	3.86^{a}	2^{a}	8.0^{a}
	-	PF1	62.0^{a}	5.95^{a}	2.67^{c}	3^{a}	12.0^{a}
	-	PF2	62.3^{a}	5.94^{a}	3.59^{b}	2^{a}	8.0^{a}
	-	PF3	61.9^{a}	6.00^{a}	4.56^{a}	2^{a}	8.0^{a}
1	ME1	PF1	62.1^{a}	5.93^{a}	2.34^{e}	3^{a}	12.0^{a}
2	ME1	PF2	62.3^{a}	5.95^{a}	3.54^{c}	3^{a}	12.0^{a}
3	ME1	PF3	61.9^{a}	6.04^{a}	4.44^{b}	2^{a}	8.0^{a}
4	ME2	PF1	62.3^{a}	5.95^{a}	2.57^{e}	3^{a}	12.0^{a}
5	ME2	PF2	62.1^{a}	5.84^{a}	3.58^{c}	2^{a}	8.0^{a}
6	ME2	PF3	61.8^{a}	6.06^{a}	4.42^{b}	3^{a}	12.0^{a}
7	ME3	PF1	61.7^{a}	5.96^{a}	3.10^{d}	2^{a}	8.0^{a}
8	ME3	PF2	62.4^{a}	6.02^{a}	3.63^{c}	2^{a}	8.0^{a}
9	ME3	PF3	62.2^{a}	5.91^{a}	4.82^{a}	2^{a}	8.0^{a}
L . S . D			1.1	0.2	0.30	1.0	4.2

a , b , c ... Means in each column, within each item, bearing the same superscripts are not significantly different ($P < 0.05$).

Mortality rate :

The effect of dietary treatments on mortality rate is presented also in Table 6 . Data showed that both the number of dead birds and percentage of mortality rate were not affected significantly (P < 0.05) by using different levels of either metabolizable energy (ME) or poultry fat (PF) . The percentage of mortality rate averaged between 8 – 12 % not due to the dietary treatments but could be attributed to hot environmental conditions . Soliman *et al* .(1999) found that mortality rate of the birds was not affected by using different levels of either dietary metabolizable energy or oil under heat stress conditions .In general, the lower mortality rate percentages were observed for chicks having either the higher ME level or fed diets with higher poultry fat addition or both .

Economic Efficiency :

The economic efficiency of the meat production was calculated based upon the differences in both growth rate and total cost . The final body weight and feeding cost are the most important factors affecting the maximum efficiency of meat production . The effect of different treatments on economic efficiency is shown in Table 7. The selling price of one Kg live body weight was 4.50 L.E at experimental time according to the market price . Results showed that when broiler chicks were fed diets containing high level of metabolizable energy (ME3) the cost / Kg body weight was decreased , while the average values of net revenue and economic efficiency (E.E) were increased compared with other levels of metabolizable energy. Also , feeding broiler chicks on diets containing high level of poultry fat (PF3) showed higher net revenue and economic efficiency values comparing to other levels of added poultry fat. This improvement in economic efficiency could be attributed to improvement in both growth rate and feed conversion ratio with using high levels of either metabolizable energy or poultry fat .

Table (7) : Effect of dietary treatments on the economical efficiency of the experimental diets.

Treatments			Fixed cost (LE)*	Feed cost (LE)	Total cost (LE)	Body Wt. (Kg)	Cost/Kg body wt. (LE)	Total revenue (LE)**	Net revenue (LE)	E.E***
No.	ME	PF								
	ME1	-	2.80	3.79	6.59	1.68	3.92	7.56	0.97	0.15
	ME2	-	2.80	3.91	6.71	1.78	3.77	8.01	1.30	0.19
	ME3	-	2.80	3.97	6.77	1.82	3.72	8.19	1.42	0.21
	-	PF1	2.80	3.95	6.75	1.72	3.91	7.74	1.02	0.15
	-	PF2	2.80	3.86	6.66	1.75	3.81	7.88	1.22	0.18
	-	PF3	2.80	3.86	6.66	1.81	3.68	8.14	1.48	0.22
1	ME1	PF1	2.80	3.87	6.67	1.65	4.04	7.42	0.75	0.11
2	ME1	PF2	2.80	3.78	6.58	1.68	3.92	7.56	0.98	0.15
3	ME1	PF3	2.80	3.72	6.52	1.71	3.81	7.69	1.17	0.18
4	ME2	PF1	2.80	3.99	6.79	1.75	3.88	7.87	1.08	0.16
5	ME2	PF2	2.80	3.86	6.66	1.76	3.78	7.92	1.26	0.19
6	ME2	PF3	2.80	3.88	6.68	1.83	3.65	8.23	1.55	0.23
7	ME3	PF1	2.80	3.99	6.79	1.76	3.86	7.92	1.13	0.17
8	ME3	PF2	2.80	3.95	6.75	1.82	3.71	8.19	1.44	0.21
9	ME3	PF3	2.80	3.97	6.77	1.90	3.56	8.55	1.78	0.26

* Bird price and rearing cost.

**Assuming that the selling price of one Kg . live body weight is (4.50) L.E

***Net revenue per unit total cost.

The results of this study indicated that the best performance of broilers during hot summer season in Egypt could be obtained by feeding broiler chicks on diets containing 3200 and 3300 Kcal ME/ Kg diet during 1 – 4 and 5 – 7 weeks of age, respectively. Moreover, when poultry fat was supplemented up to 6 % to such diets, the best findings of growth and economic efficiency my be obtained .

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تأثير المستويات المختلفة من الطاقة الممثلة والدهن على الأداء الإنتاجى لبدارى التسمين تحت ظروف الإجهاد الحرارى .

عبدالله على غزاله و ممدوح عمر عبد السميع
قسم الإنتاج الحيوانى - كلية الزراعة - جامعة القاهرة - الجيزة - مصر .

تم تقسيم عدد ٦٧٥ كتكوت تسمين عمر يوم من نوع الأربرايكرز إلى ٩ مجموعات تجريبية (بكل منها ثلاث مكررات ويحتوى كل مكرر على ٢٥ طائر) . حيث استخدم ثلاث مستويات من الطاقة الممثلة وثلاث مستويات من دهن الدواجن فى تصميم إحصائى متداخل ٣ × ٣ وذلك بهدف تجنب التأثير الضار للإجهاد الحرارى (٢٩- ٣٦ ° م) على الأداء الإنتاجى لبدارى التسمين . وكانت مستويات الطاقة الممثلة المختبرة ٣٠٠٠ ، ٣١٠٠ ، ٣٢٠٠ كيلو كالورى / كجم عليقة فى فترة النامى (من ١ - ٤ أسابيع من العمر) . بينما خلال فترة الناهى (من ٥ - ٧ أسابيع من العمر) كانت مستويات الطاقة الممثلة ٣١٠٠ ، ٣٢٠٠ ، ٣٣٠٠ كيلو كالورى / كجم عليقة . أما دهن الدواجن فقد أضيف بمستويات صفر ، ٣ ، ٦ % من العليقة لكل مستوى من مستويات الطاقة الممثلة المختبرة خلال فترتى التجربة . كانت مستويات البروتين الخام ثابتة خلال فترة النامى (٢٣ %) وفترة الناهى (٢٠ %) . تم تربية الطيور على الأرض فى عنبر مفتوح تحت نفس الظروف من الرعاية والمعاملات البيطرية حتى الأسبوع السابع من العمر .

أوضحت نتائج هذه التجربة أن تغذية بدارى التسمين على علائق تحتوى على المستوى المرتفع من الطاقة الممثلة أو دهن الدواجن أدى إلى التحسن المعنوى فى قيم كل من وزن الجسم الحى ، الزيادة فى الوزن ، معدل التحويل الغذائى ، دليل الأداء الإنتاجى مقارنة بمجموعة الطيور المغذاه على المستويات الأخرى من الطاقة الممثلة أو دهن الدواجن وخاصة خلال فترة الناهى . بالنسبة لقيم معاملات الهضم أوضحت الدراسة أن استخدام المستوى المرتفع من الطاقة الممثلة أو دهن الدواجن أدى إلى الزيادة المعنوية فى قيم معاملات هضم كل من البروتين الخام والدهن الخام بينما لم يكن هناك تأثير معنوى بالنسبة لمعاملات هضم كل من الألياف الخام والمستخلص الخالى من الأزوت . لم يكن هناك تأثير معنوى للمعاملات على قيم خصائص الذبيحة فيما عدا الزيادة المعنوية لقيم الدهن الحشوى نتيجة لإستخدام المستوى المرتفع من الطاقة الممثلة أو دهن الدواجن . لم يكن هناك فروق معنوية فى قيم معدل النفوق لإختلاف المعاملات التجريبية . بالنسبة لقيم الكفاءة الإقتصادية لوحظ أن استخدام المستوى المرتفع من الطاقة الممثلة أو دهن الدواجن سجل اعلى القيم للكفاءة الإقتصادية .

من هذه الدراسة ينصح بتغذية بدارى التسمين على علائق مرتفعة فى محتواها من الطاقة الممثلة عن المستوى الموصى به خلال فترتى النامى والناهى مع إضافة الدهن بمستوى ٦ % من العليقة خلال فترتى التجربة وذلك لتقليل التأثيرات الضارة عند تعرض الطيور إلى الإجهاد الحرارى .