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PERFORMANCE AND PHYSIOLOGICAL ASPECTS OF BROILER CHICKS FED DIETS CONTAINING VARIOUS LEVELS OF CANOLA MEAL

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ABSTRACT

One hundred and fifty day–old Hubbard broiler chicks were used to investigate the effect of including low canola meal (Brassica campestris cv. Pactol) into broiler diets on their performance, internal organs relative weights and histology of liver and thyroid gland and economical efficiency throughout different growth stages. Birds were fed three periodical diets; starter, grower and finisher, based on corn- soybean meal. Canola meal (CM) was included into diets with levels of 0 (control), 10%, 12.5%, 15%, and 20%.

The results indicated that, feed intake values were not affected by including canola meal into diets at different intervals (0-21, 22-32; 33-42 day), however feed consumption of chicks fed 20% canola was significantly lower for the entire experimental period. Body weight gain of chicks fed 20% canola meal were significantly lower than control ,while including canola meal up to 15% has no effect on body weight. Feed conversion ratio was not affected by 5% inclusion of canola meal, however, a negative but insignificant effect was observed with level of 10%. The relatives weight of each of dressing carcass, abdominal fat, liver, and spleen were not affected by including canola meal into diets. Thyroid gland percentage significantly increased due to incorporating canola meal into diets. Histological examination of liver and thyroid gland sections showed slight changes in the hepatocytes and thyroid follicles coincident with the level of canola meal inclusion level. In spit of included graded levels of canola meal into diets reduced total feed cost, the net revenue value of high inclusion level 20% (4.66LE) was lower than the control (4.9LE). As well, European efficiency factor and Performance index showed better values for control than canola meal feeding groups. It is concluded that 15% of CM in broiler diet is sufficient to obtain good performance and economical benefits without adverse effects on physiological status of birds.

Keywords: Canola meal – broiler performance – physiological effects – economical efficiency.

INTRODUCTION

In the most world countries, soybean meal is used as a main source of protein in poultry rations and represents about one third of diet weight. However using of soybean meal as a sole plant protein source may be uneconomic in some countries, especially when cheaper alternatives are present.

Canola seed is cultivated worldwide and about 33.6 million tons of canola are produced for oil production in the world (FAO, 1999) due to its high content (40%) of oil (Aherne and Bell, 1990).

After oil extraction, 17.7 million tons of canola meal is produced and available for using in animal and poultry nutrition. According to NRC (1994) canola meal contains 38 % crude protein and 2000 kcal ME. Although, some

research workers showed an antinutritional factors in canola meal such as glucosinolates and sinapin, (Ciska and Kozlowska, 1998), and non-starch polysaccharides (Kocher *et al.*, 2000), the genetic improvement centers were able to produce a low glucosinolates and low erucic acid strains of canola seed (exceptionally named double zero canola).
The term of "Double Zero canola seed " is an exceptionally term because this variety is one of the modern safe variety which containing less than 30 µmole glucosinolates/gm. seed, and less than 2% erucic acid of total lipids content (Bell, 1993).

Therefore the researches were intensified to determine the most tolerant and economical level of these new varieties of canola meal for broiler chicks where the recommended level reached to 25% in Summers *et al.* (1993) research, but Abdallah *et al.* (2003) indicated that 17% is the most profitable level. While, Newkirk and Classen (2002) and Figueiredo *et al.* (2003) indicated that 20% commercial CM could be used in broiler ration without adversely effect on productive performance.

Recently, a large quantity of canola meal has been introduced into Egyptian market with cheaper price than the other plant protein sources. Because of the previous findings concerning the possible deleterious effects of rapeseed varieties on liver function (El-wardany and Karima, 1995 and Maroufyan and Kermanshahi, 2003) and hypothyroid activity resulted from goitrogens present in CM which cause lower plasma thyroidal hormone concentration and subsequently growth performance retardation (El-wardany and Karima, 1995, Kocher *et al.*, 2000, Qiao and Classen, 2002, Kermanshahi and Abbasi, 2006 and Taraz *et al.*, 2006).

Therefore, the current study aimed to investigate the effect of including canola meal into broiler diets on their performance, internal organs weight and histology of liver and thyroid gland. As well the economical efficiency of using canola meal in broiler diets was included.

MATERIALS AND METHODS

One hundred and fifty, day–old Hubbard broiler chicks were randomly allocated into five treatment groups of 30 chicks, which were divided into five replicate groups of 6 birds each. The chicks were grown in battery cages. Feed (mash) and water (automatic nipples) were provided ad lib. The chicks were fed on three periodical diets, starter, grower, and finisher (Table 1) which were formulated to satisfy broiler requirements according to NRC (1994). Canola meal (Brassica campestris cv. Pactol) of 00–type was included into diets by five levels as 0% (control), 10%, 12.5%, 15%, and 20% as partially replacement of dietary soybean meal.

Along the fattening period, chicks were subjected to 24 hours artificial light during the 1st. week and 22 h. during the other periods, and vaccinated against Newcastle disease by Hitchner B1 vaccine at 3 days, and Gumboro disease at 10 day-old, and Lasota vaccine at 17 and 24 day-old, respectively. All previous vaccines were given in the drinking water.

Productive performance data were measured for the three periods and include feed consumption (g/bird), body weight gain (g.) and feed conversion ratio (expressed as feed consumption / body weight gain, g).

Table (1): composition and calculated analysis of the experimental diets.1- starter

Ingredients (%)	Control	10% CM	12.5% CM	15% CM	20% CM
Yellow corn	55.88	54.38	54.20	54.07	53.30
Soy bean (44%)	25.00	15.00	12.50	10.00	5.00
Gluten (62%)	11.70	13.00	13.25	13.52	14.20
Canola meal[@]	0.00	10.00	12.50	15.00	20.00
Limestone	1.57	1.52	1.60	1.59	1.60
Di ca, ph	1.50	1.38	1.31	1.20	1.20
Premix [#]	0.40	0.40	0.40	0.40	0.40
Oil	3.40	3.65	3.67	3.67	3.75
Common Salt	0.25	0.25	0.25	0.25	0.25
Meth.(DL)	0.10	0.12	0.10	0.10	0.10
Lysine(HCl)	0.20	0.30	0.30	0.20	0.20
Calculated analysis: ME kcal/kg= 3200, c.p. (%)=23, Ca (%)=1.01, Av. Phos. (%)=0.45, Meth. + cyst.(%)=0.94, Lysine (%)= 1.14					
2- Grower :					
Yellow corn	61.25	60.45	60.25	60.00	59.23
Soy bean 44%	25.00	15.00	12.50	10.00	5.00
Gluten (62%)	6.20	7.30	7.60	7.86	8.50
Canola meal	0.00	10.00	12.59	15.00	20.00
Limestone	1.55	1.50	1.47	1.47	1.47
Di ca, ph.	1.30	1.10	1.00	1.02	1.02
Premix	0.40	0.40	0.40	0.40	0.40
Oil	3.65	3.74	3.75	3.80	3.93
Common Salt	0.25	0.25	0.25	0.25	0.25
Meth. (DL)	0.10	0.11	0.00	0.00	0.00
Lysine(HCL)	0.30	0.15	0.20	0.20	0.20
Calculated analysis: ME kcal/kg= 3200, c.p. (%)=20, Ca (%)=0.93, Av. Phos. (%)=0.40, Meth. + cyst.(%)=0.80, Lysine (%)= 1.02 **3-Finisher**:					
Yellow corn	65.87	64.80	64.45	64.00	63.60
Soy bean 44%	25.00	15.00	12.50	10.00	5.00
Corn gluten meal	2.38	3.50	3.80	4.10	4.66
Canola meal	0.00	10.00	12.50	15.00	20.00
Limestone	1.38	1.15	1.24	1.30	1.10
Di ca ph.	1.00	1.01	0.90	0.99	0.99
Premix	0.40	0.40	0.40	0.40	0.40
Oil	3.52	3.69	3.76	3.86	3.90
Common Salt	0.52	0.25	0.25	0.25	0.25
Meth. (DL)	0.10	0.10	0.10	0.00	0.00
Lysine (HCl)	0.10	0.10	0.10	0.10	0.10
Calculated analysis: ME kcal/kg= 3200, c.p. (%)=18, Ca (%)=0.80, Av. Phos. (%)=0.40, Meth. + cyst.(%)=0.73, Lysine (%)= 0.91					

[#] Each 1.5 kg. of premix per 1 ton of feed include: 13000000 I.U. VIT. A, 3000000 I.U. VIT. D3, 15000 mg. VIT. E, 3000 mg. VIT. K3, 2000 mg. VIT. B1, 6000 mg. VIT. B2, 3000 mg. VIT. B6, 15 mg. VIT. B12, 10000 mg. Ca D – Pantothenate, 40000 mg. Niacin, 1500 mg. Folic acid, 75 mg. Biotin, 100 gm. Mn, 80 gm. Zn, 90 gm. Iron, 10 gm. Cu, 1 gm. Iodine , 0.3 gm. Se, 0.15 gm. Cobalt and 600 gm. Choline, where $CaCo_3$ were taken as a carrier .[@] Chemical composition of CM used in present study was calculated according to chemical analysis as shown in Table 2.

Histological section of livers and thyroids:

Representative tissue samples from both liver and thyroid gland were taken immediately after slaughtering, and then fixed in 10% formalin–saline solution for 24 h. Therefore, all samples were kept in a 70% alcohol solution until used for preparation of transverse sections (T.S) by applying the paraffin method technique. All sections were stained with haematoxylin and eosin stain, examined under light microscopes (X400) and then photographed by using special Canon digital camera.

Slaughter traits and samples collection:

At the end of the experiment (42 days-old), 5 birds per treatment representing the 5 replicate groups were chosen and slaughtered to evaluate the carcass traits as a percentage of live body weight. Carcass traits included dressing percentage, liver, spleen, thymus, thyroid, abdominal fat, and bursa relative weights.

The economical study was done based on the feed cost, and final body weight price. Economical efficiency was calculated on basis of the European Efficiency Factor (EEF) and the Performance Index (PI) was determined according to North (1981).

Statistical analysis: Data were subjected to one-way analysis of variance with percentages of canola meal used as the main effect using the General Linear Model (GLM) procedure of SAS user's Guide, (1988) according to the following model: $Y_{ijk} = \mu + C_i + e_{ik}$. Where; μ = overall mean, C_i = percentages of canola meal, e_{ik}= experimental error. Means were compared by using Duncan's multiple range tests at α level equal to 0.05 and 0.01.

Table (2): Chemical analysis of canola meal (Brassica napus):

Item	% of dry matter "DM"
Crude protein	38.101
Ether extract	7.151
Ash	5.062
Crude fiber	12.301
Calcium	0.681
Total phosphorus	1.660
Available phosphorus "Calculated "	0.499
Methionine	1.355
Lysine	2.101

RESULTS AND DISCUSSION

Performance traits:

Effect of including graded levels of canola meal (CM) on performance of broiler chicks are shown in Table (3). The values of feed intake were not affected by including canola meal into diets at different intervals (0-21, 22-32 and 33-42). However for the entire experimental period (0-42 day), feed consumption of chicks fed 20% canola meal was significantly lower than control. This result is in agreement with those of Maroufyan and Kermanshahi (2006), who showed that including high level of canola meal into broiler diet decrease feed consumption values.

Body weight gain of chicks fed 20% canola meal was significantly lower than the control either at different intervals or for the entire period. While included canola meal up to 15% has no significant effect on body weight gain of broiler chicks. These results are in a good agreement with those recorded by Heinz *et al.* (1987), who didn't observed any differences in body weight of broilers chicks fed diets enriched with graded levels of 00–variety (low glucosinolates) rapeseed meal. While including canola meal Up to 15% has no significant effect on body weight gain of broiler chicks. These results are in a good agreement with those recorded by Heinz *et al.* (1987) who did not observe any differences in body weight gain of broilers fed diets enriched with graded levels of 00-variety (low glucosinolates) of rape seed meal up to 15%. However, Fasina and Campbell (1997) reported that high levels of canola meal negatively affected body weight gain of broiler chicks. They added that the level of canola meal should not exceed 10% in broiler diet.

Feed conversion ratio of chicks fed 20% canola meal diet was significantly lower than control either at the earlier age or for the overall value. Mateo *et al.* (1999) observed an impairment in feed utilization of broiler chicks fed more than 10% canola meal in their diets. As well, the current result is in a good agreement with those of Zafar *et al.* (1999) who included canola meal in broiler diets with 5%, 10%, 15%, and 20%. They did not find any differences in feed conversion ratios between control and 5% canola meal, which negatively affected beyond 10% level.

Table (3):Effect of feeding different levels of canola meal on performance of broiler chicks

Period	Control	10% CM	12.5% CM	15% CM	20% CM	Sig.
Feed consumption (g.)						
1 to 21 d.	1016 ±11.1	998 ±12.3	1009 ±16.0	987±12.0	982±16.7	N.S.
22 to 32 d.	1376 ±6.7	1361±11.1	1366 ±10.6	1375 ±12.3	1354±10.5	N.S.
33 to 42 d.	1594 ±7.8	1601±9.6	1594±9.8	1591±12.4	1578±12.2	N.S.
l 0 to 42 d.	3987^{a} ±16.5	3961^{ab} ±14.7	3970^{ab}±21	3954^{ab}±21.2	3915^{b}±21	**
Body weight gain (g.)						
0 - wt (g)	48 ± 0.43	46 ± 0.54	48 ± 0.57	48±0.59	46±0.59	N.S.
1 to 21 d.	693 ± 9.8^{a}	684 ± 11.2^{a}	678 ± 13.9^{a}	673±14.5^{a}	630±10.8^{b}	**
22 to 31 d.	684 ± 7.9^{a}	663 ± 8.9^{ab}	654 ± 13.7^{ab}	668±14.8^{ab}	644±11.1^{b}	*
32 to 42 d.	685 ± 7.0^{a}	677 ± 11.4^{a}	672 ± 14.2^{ab}	659±13.5^{ab}	642±13.3^{b}	*
0 to 42 d.	2063± 14.5^{a}	2025 ±20.3^{a}	2005±26.6^{a}	2001±27.4^{a}	1917±19.3^{b}	**
Feed conversion (g feed / g gain)						
1 to 21 d.	1.47±0.02^{b}	1.45±0.01^{b}	1.49±0.01^{ab}	1.47±0.03^{b}	1.55±0.01^{a}	*
22 to 32 d.	2.02±0.02	2.06±0.02	2.09±0.03	2.06±0.04	2.10± 0.030	N.S.
33 to 42 d.	2.33±0.02^{b}	2.37±0.04^{ab}	2.38±0.05^{ab}	2.42±0.04^{ab}	2.48± 0.05^{a}	*
1 to 42 d.	1.93±0.01^{b}	1.95±0.02^{b}	1.98±0.02^{ab}	1.98±0.02^{ab}	2.04± 0.02^{a}	*

^{abcde}, Means with different letters within the same row are significantly differed.

*** p<0.01 ** p<0.05 N.S. non significant difference**

Generally, the current study revealed that, the low glucosinolate type of canola meal can be included into broiler diets up to 15%, beyond that it can cause deleterious effects on broiler performance .This deleterious effect of canola meal may be related partly to its high content of crude fiber 12.3% (Table 2) and non-starch polysaccharides (Slominski and Campbell, 1990) that increased the viscosity of digesta and reducing subsequently nutrients digestion and absorption (Ammison, 1991; Abdallah *et al.* 2003). As well, the presence of low glucosinolates level (less than 30µm/g as reported by Bell, 1993) could cause significant antinutritional and toxic effect (Elwinger and Saterby 1980), in addition to reduce feed intake (0-21day) which assured reflect on growth rate especially at the early stage of growth (Newkirk and Classen, 2002).

Dressing carcass and some internal organs:

Relative dressing carcass and internal organs weight are shown in Table (4). Dressing carcass percentages were not affected significantly by including canola meal into diets. This result disagree with those of Abdallah *et al.* (2003) who observed a significant reduction in dressing weight of broilers fed more than 17% canola meal. This disagreement may be related to the differences in canola meal type, and experimental conditions in both studies and the level of CM used.

Abdominal fat percentages were not affected by including canola meal into broiler diets with the exception of 20% level that increased abdominal fat. This result disagree with the result of Abdallah *et al.* (2003) who observed a significant increase in abdominal fat of broilers fed different graded level of canola meal. This disagreement may be related to the fat content of canola meal that depends upon extraction methods of canola seed. Liver weights were not affected by treatment.

Both of thymus and spleen were not affected by feeding canola meal ‘as well bursa weight was not affected except at 20% canola meal level. Qiao and Classen (2002) did not find any effect on bursa or spleen weight due to feeding canola meal. While Slominski and Campbell, (1991) reported that lymphoid organs could be affected by canola meal).

Thyroid gland percentages were significantly increased due to incorporating canola meal into broiler chick diets. This result are in harmony with those recorded by Nassar and Arscott (1986), Slominski and Campbell (1990), and Kinal *et al.* (1994), that canola meal cause enlargement of thyroid gland. They attributed this enlargement to the presence values of glucosinolates, which leads to hyperthyroidism and alter the ratio between T3 and T4 in the blood.

Table (4): Dressing percentage and the relative weights of some organs in broiler chicks for different levels of canola meal:

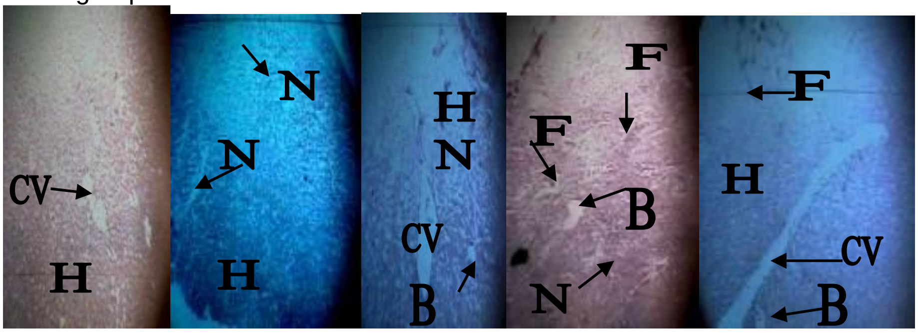
Item	Control (R)	10% CM(R1)	12.5% CM (R2)	15% CM (R3)	20% CM (R4)	Sig.
Dressing %	71.89±0.33	72.56 ±0.60	72.83±1.68	71.68±0.7	71.89±0.97	N.S
Abdominal fat %	2.31^{b}±0.24	2.59^{b}±0.23	2.22^{b}±0.33	2.15^{b}±0.3	3.03^{a} ±0.35	*
Liver %	2.40 ±0.23	2.81±0.26	3.01±0.34	3.12±0.4	2.57 ±0.09	N.S.
Thyroid %	0.012^{c}±0.0	0.018^{ab}±0.0	0.018^{ab}±0.0	0.016^{b}±0.0	0.022^{a} ±0.0	*
Thymus %	0.78 ±0.14	0.78 ±0.08	0.51±0.04	0.61±0.2	0.78 ±0.11	N.S.
Bursa %	0.18^{b}±0.07	0.18^{b}±0.01	0.20^{b}±0.04	0.19^{b}±0.1	0.26^{a} ±0.05	*
Spleen %	0.13 ±0.01	0.12 ±0.01	0.11±0.02	0.14±0.1	0.14 ±0.02	N.S.

^{abcde}, Means with different letters within the same row are significantly differed.

*** p<0.01 N.S. non-significant difference**

Histological examination of liver and thyroid glands:

Histological examination of liver (Fig. 1) showed a normal cellular structure of hepatocytes in the control and in the 10% canola treated group. However, a slight enlargement of the hepatic central vein accompanied with several necrotic areas was observed in birds group fed on 12.5% CM. The high inclusion rates (15 and 20%) showed signs of liver infiltration along with hepatocytic atrophy and dilated bile ducts. This histological changes were more relevant in the 20% CM group, however, no signs of hepatocytes damage or bile system was occurred during the whole experimental period for all groups.



Control 10% CM 12.5% CM 15% CM 20% CM

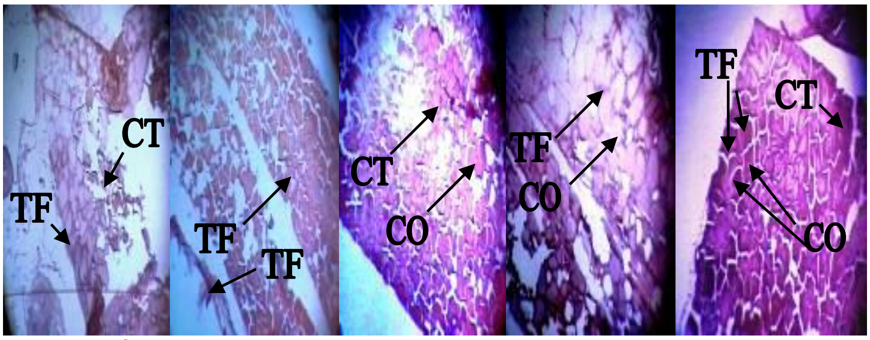
B= bile duct, CV=central vein, H=hepatocyte, F=fibrotic area, N=necrotic area.

Fig. (1): T.S. in the liver tissue of broiler chicks fed different levels of canola meal :

Regarding to the histology of thyroid glands Fig. (2), it is clear that the functional units (thyroid follicles) in the 10% CM group was slightly enlarged but with a considerable amount of colloidal material present within the follicles. Beside, the lining epithelial cells were somewhat columnar in the appearance indicative of euthyroid status. However, the thyroid follicle of the 15 and 20% CM groups showed a considerable structural changes including, polyhederal appearing , diameter increase, cuboidal epithelium linning (especially in the 20% CM group) and an accumulation of colloid in the follicle. There is also some intra-thyroidal fibrotic areas due to the agumentation of the connective tissue fibers in between the thyroid follicles.

It appears from the results that the CM has non-toxic deleterious effect on liver and thyroid function when the inclusion rate mounted 12.5 up to 15%. This may be due to its low content of glucosinolates and eurucic acid which support the recent finding that CM, especially Brassica Napus (Pactol variety) had low glucosinolates and eurucic acid content (Bell, 1993).

Hepatic damage and thyroid dysfunction which were observed in our study by higher inclusion rate of CM (especially 20% and to lesser extent 15%) may reveal the incidence of a very low goitrogenic effects which may result from glucosinolate substances liberated as from hydrolysis. Many authors reported this effect by using various rapeseed varieties that causes elaboration of some goitrogenic compounds including nitrils, isothiocyanates and the goitrin compounds (Δ5- vinyl-2- oxazolidinthione, OZT). These compounds were the most limiting factor(S) for higher inclusion rates of CM in broiler diets (El- Wardany and Karima, 1995; Janjecic *et al.*, 2002, and Kermanshahi and Abbasi, 2006).



Control 10% CM 12.5% CM 15% CM 20% CM

CT = connective tissue cells, CO=colloid, TF=thyroid follicle

Fig. (2):T.S. in the thyroid glands of broiler chicks fed different levels of canola meal:

Economic efficiency: Economic efficiency of including canola meal into broiler diets is shown in Table (5).

Table (5): Effect of canola meal levels on economic performance of different broiler chicks.

Item	Control R	10% CM R1	12.5 %CM R2	15%CM R3	20%CM R4
Total feed cost\ broiler (L.E.)	5.56	5.27	5.23	5.09	4.92
Fixed cost (L.E.)	2.20	2.20	2.20	2.2	2.2
Total cost	7.76	7.47	7.43	7.29	7.12
Final body weight \ (kg)	2.11	2.07	2.05	2.05	1.96
Livability %	95.00	95.00	96.00	98.00	97.00
Selling price\ kg live weight(L.E.)	6.00	6.00	6.00	6.00	6.00
Selling revenue L.E.	12.66	12.42	12.31	12.29	11.78
Net revenue \ chicks L.E.	4.90	4.95	4.88	5.00	4.66
Economic efficiency	0.63	0.66	0.65	0.68	0.65
Overall feed conversion ratio	1.89	1.91	1.93	1.93	1.99
Livability % x final weight (L.E.)	2.00	1.96	1.97	2.00	1.90
European Efficiency Factor (EEF)	252.63	245.25	243.14	247.72	227.82
Performance index (PI)	111.69	108.42	106.37	106.16	98.64

L.E. = Egyptian Pound
Selling revenue/ chick = selling price /kg live weight X average final body weight of chicks x livability /100
Net revenue / chick = selling revenue – (total feed cost + price of day – old chicks)
Fixed costs = price of one – day chick L.E.+ Medication
Economic efficiency = Net revenue\ chick L.E./ total costs.

$$\text{EEF} = \frac{\text{Livability (\%) x live weigh (kg)}}{\text{Age (day) x feed conversion ratio}} \text{ X 100}$$

PI=Live body weight (kg)/feed conversion X 100

In spite of included graded levels of canola meal into diets linearly reduced total feed cost, the net revenue value of high inclusion level 20% (4.66L.E.) was lower than control (4.9L.E.). This may be attributed to the impairment in the efficiency of feed utilization (1.99) at this level of inclusion compared with control (1.83).

Similar result was obtained by Abdallah *et al.* (2003) who observed a reduction in net revenue of broiler chicks fed more than 17% canola meal under Egyptian conditions.

This result was ensured by determinining the European efficiency factor and performance index which showed the overcome of control diet on canola meal diets.

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الاداء الانتاجى والصفات الفسيولوجيه لكتاكيت اللحم المغذاة على علائق تحتوى مستويات مختلفه من كسب الكانولا

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اجريت هذه التجربة لمعرفة تأثير إدراج مستويات مختلفة من كسب الكانولا " نوع باكتول المنخفض المحتوي من حمض الايروسيك والجلوكوسينولات " علي الاداء الانتاجى لكتاكيت اللحم والوزن النسبي لبعض الاعضاء الداخليه والتركيب الهستولوجى للكبد والغدة الدرقيه وكذلك دراسة الكفاءة الاقتصادية لاستخدام كسب الكانولا فى غذاء كتاكيت اللحم. استخدمت الدراسة ١٥٠ كتكوت هبرد عمر يوم تم تغذيتها على ٣ علائق تجريبية (البادئ –نامى – ناهي).تحتوى ٥ مستويات مختلفة من كسب الكانولا وهى: صفر (الكنترول) و١٠٪ و١٢,٥٪ و١٥٪ و٢٠٪.

أشارت اهم النتائج الى انه :

- لم يتأثير الاستهلاك الغذائى نتيجة ادراج كسب الكانولا فى علائق كتاكيت اللحم حتى ١٥٪ بينما كان هناك انخفاض فى معدل الاستهلاك الغذائى عند مستوى ٢٠٪ كسب كانولا.
- إدراج كسب الكانولا بنسبة ٢٠٪ فى علائق كتاكيت اللحم أدى لانخفاض معنوى فى وزن الجسم بينما لم يكن هناك تأثير لباقى المعاملات على وزن الجسم.
- معدلات التحويل الغذائى لم تتأثر بإضافة الكانولا بنسبة ٥٪ ولكن ظهرت تأثيرات سلبيه (ولكن غير معنوية) بداية من إستخدام مستوى ١٠٪ فى غذاء الكتاكيت.
- لم يكن هناك تأثير معنوى لكسب الكانولا على صفات الذبيحه ووزن الاعضاء الداخليه. ازداد الوزن النسبى للغدة الدرقيه نتيجه لاضافة الكانولا لعلائق كتاكيت اللحم.
- معدلات الكفاءة الاقتصادية أوضحت انه بالرغم من انخفاض التكاليف الكليه للتغذيه إلا أن صافى الربح للكتاكيت المغذاة على مستوى ٢٠٪ كانولا (٤,٦٦ جنيه) كان اقل من مثيله فى المجموعة الكونترول (٤,٩ جنيه).
- اتضح من الفحص الهستولوجي لقطاعات الغدة الدرقية والكبد وجود بعض التغيرات البسيطة في التركيب النسيجي للخلايا الكبدية والحويصلات الدرقية وكانت حدة هذه التغيرات متناسبة مع مستوي اضافة كسب الكانولا.

وقد خلصت الدراسة الى امكانية اضافة كسب الكانولا بمعدل ١٥% الى علائق بدارى اللحم للحصول على اداء انتاجي واقتصادي جيد دون احداث أي اضرار او تاثيرات فسيولوجية غير مرغوبة للطيور.