USE OF CRUDE GLYCERIN IN BROILER DIETS

By

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Abstract: *The present work was conducted to evaluate crude glycerin as untraditional energy source in broiler diets through determination of the chemical composition of tested crude glycerin, AME of crude glycerin and evaluating the effect of increasing levels of crude glycerin in broiler diets on growth performance, carcass characteristics and blood constituents. In this study, 300 one-day old Arbor Acres broiler chicks were used. During the first week of age chicks were fed a starter corn-soy diet without glycerin, then chicks were randomly allocated to 5 treatments, with 3 replicates and 20 birds each in a completely randomized design. Broilers fed diets containing five levels of crude glycerin, 0, 2, 4, 6, and 8% of the diet. The data of body weight, feed consumption were recorded weekly and feed conversion ratio was calculated. The analysis of crude glycerin that was obtained from local soap manufacturer was 84.65% glycerol, 10.17% moisture, 3.41% Na, and 3,445 kcal/kg gross energy, AME was 3312 kcal/kg. Birds fed diets with glycerin did not differ significantly in performance from those fed the control diet without glycerin. The level of 6% crude glycerin recorded the highest body weight and body weight gain and the best feed conversion ratio at 42 days and during the over all period, while the level of 2% crude glycerin gave the lowest body weight and the worst feed conversion ratio. The average values of economical efficiency were improved with feeding broiler chicks on diets containing different levels of crude glycerin especially with level of 6 %. The average values of digestion coefficients, carcass characteristics and blood constituents were not significantly affected by treatments. In conclusion, crude glycerin may be incorporated to a level of 8% in the diet of broiler chicks without any detrimental effect on broiler chick performance, nutrient digestibility and carcass characteristics.*

INTRODUCTION

Feeding cost of poultry is usually considered the most expensive item, and energy represents the greatest proportion of this cost. The price of corn and oils has increased during the past years and high prices may continue with increasing demand for this ingredient as an input for biofuel production. Thus, an alternative energy source needs to be identified for poultry diets due to this increasing. Currently there is a lot of focus on the use of crude glycerol as a less expensive energy source in poultry diets. Glycerin, known as glycerol or glycerine, is the principal co-product of biodiesel production, produced through a NaOH- or KOH-catalyzed transesterification of the triacylglycerols in oils or fats with an alcohol. Glycerin is known to be a valuable ingredient for producing food, soaps, cosmetics and pharmaceuticals. Currently, with plenty of glycerin available to the world market, more uses are expected to develop, especially as a potential energy source for poultry diets, with approximately 4,100 kcal/kg gross energy **(Min *et al*., 2010).**

With the annual world production of biodiesel expected to increase to over four billion liters by the end of this decade, the projected amount of the crude glycerol co-product of the process will increase to over 400 million liters per year. For larger biodiesel facilities that refine and sell glycerol, the increased glycerol supply has resulted in lower glycerol prices **(Chiu *et al*., 2006).** Also, there has been greater awareness on biodiesel in developing countries in recent times and significant activities have picked up for its production, though Egypt is currently looking into the expansion of the cultivation of jatropha plant in upper Egypt as a means of producing biodiesel within the national programme for safe use of treated sewage water **(Egyption Environmental Affairs Agency Report 2008**).

Glycerol is a sugar alcohol that exists naturally in foods and in living tissues. It is constantly being produced by the hydrolysis of lipids in the gastrointestinal tract and absorbed by the mucosa. Glycerol readily forms neutral fats, fatty acid esters, and phosphoglycerides that are widely distributed in living organisms **(Tao *et al.,* 1983)**

Several researchers have reported that glycerin is an acceptable feed ingredient for broiler chicks up to 5% without adverse effect on performance, dressing percentage or yield of various carcass parts **(Lessard *et al.,* 1993; Cerrate *et al.,* 2006** and **Min *et al.,* 2008)**. However, increasing dietary glycerin above 10% has been shown to adversely affect growth performance and meat yield of broiler chickens, although this may be due to feed flow ability and associated feed consumption **(Cerrate et al.,**

2006). Also, **Simon (1996)** and **(Simon *et al*., 1996** and **1997)** indicated that adding glycerol content up to10% of broiler diet did not affect broiler performance. **(Lammers *et al.*, 2008)** found no significant effect of using crude glycerin up to 15% of the diets on feed consumption, egg production, egg weight, or egg mass of laying hens**.** Similarly, **Yalçın *et al.*(2009)** adding up to 7.5% and they found t no effect on egg quality characteristics, total saturated and total unsaturated fatty acids. Feeding 16 weeks old large white turkey hen on a diet containing 14.5% glycerol had no significant effect on body weight, feed intake and egg production (**Rosbrough *et al*., 1980)**. Research determining the energy value of crude glycerol is limited. Recently, **Dozier *et al*. (2008)** estimated the apparent metabolizable energy (AME) of crude glycerol for broiler chickens to be 3434 kcal/kg. While, **Lammers *et al.* (2008)** found a value of 3805 kcal/kg for laying hens.

This work was conducted to evaluate the effect of feeding broiler chicks on diets containing crude glycerin on their performance, digestibility coefficient of nutrients, carcass characteristics, blood parameters and economical efficiency.

MATERIALS AND METHODS

The experimental part and the laboratory work of the present study were carried out at Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza. Crude glycerin obtained from local soap manufacturer

Crude glycerin evaluation

Chemical analysis of crude glycerin, were determined according to the procedures outlined by Association of Official Analytical Chemists **(A.O.A.C, 2000).** Glycerol percent of crude glycerin was carried out at Department of Chemistry National Research Center and Animal Production Research Institute. Data are provided in Table (1).

Apparent metabolizable energy of crude glycerin was calculated based on data obtained from determination of gross energy of experimental diets and excreta as suggested by **Matterson et al. (1965)**

AME of crude glycerin was calculated using the following formula:

$$AME_{ing} = (AME_{ref} + (AME_{test} – AME_{ref}))/ (\% \text{ replacement}/100)$$

Where:

ing: tested ingredient

ref : reference diet

test: basal diet + tested ingredient

% replacement : substitution level of basal diet for the tested ingredient

To determine the AME, 27 local breed cockerels (Dokky 4) at 28 weeks old were divided into 3 groups each reared in individual cages and crude glycerin was substituted at 0, 10 and 20% of the basal diet (yellow corn). The trial continued for 3 days after 4 days adaptation period. The excreta was collected daily and feed intake was recorded. Samples of feed and excreta were assayed for gross energy in standard adiabatic bomb colorimeter.

Experimental design:

A total number of 300 unsexed one day-old Arbor Acres broiler chicks obtained from local hatchery were used in this study. During the first week of age chicks were fed on a starter corn-soy diet without glycerin. At the seventh day of age the chicks were randomly allocated to 5 treatments, with 3 replicates and 20 birds per each replicate in a completely randomized design. Birds were kept in previously cleaned and fumigated cages of wire floored batteries in an open system house. The average initial live body weights of different groups were nearly similar (about 105 gram). Diets were formulated for starter period (7- 14 d), grower period (15 – 28 d) and finisher period (29 – 42 d) based on the requirements of broiler chicks according to the strain recommended catalog. Crude glycerin was supplemented at levels of 0, 2, 4, 6 and 8 % of the diet. The composition and calculated analysis of starter, grower and finisher diets according to **NRC (1994)** are shown in Tables 2, 3 and 4. Experimental diets and water were offered *ad-libitum* all over the experimental periods. Body weight and feed consumption for all groups were recorded weekly. At the end of trial, three chicks of each treatment (one from each replicate) were randomly chosen and individually housed in metabolic cages to determine the digestibility coefficient of nutrients. The analyses of feed and dried excreta were done according to the official methods of the **A. O. A. C. (2000)**. Fecal nitrogen was determined according to **Jakobson *et al.* (1960)**.

Carcass and plasma measurements:

At the end of the growth trial period, three representing birds of each experimental group were fasted overnight, slaughtered and eviscerated. Weights of hot carcasses, liver, heart, abdominal fat, and immune organs (thymus, bursa of fabricious and spleen) each was proportioned to the live body weight upon slaughtering. Chemical analyses of plasma were carried out for quantitative determination of blood parameters (plasma total proteins, albumin, total lipids, cholesterol, HDL-cholesterol, LDL-cholesterol, AST, ALT, alkaline phosphatase, urea, creatinine, uric acid and glucose) which were colorimetrically determined using commercial kits, following the same steps as described by manufactures.

Economical efficiency:

Finally, all treatments were economically evaluated by using two methods; the first was the total cost needed to obtain one-kilogram body gain and the second was the net revenue per unit of total cost. Results showed that the average values of economical efficiency were improved with feeding broiler chicks on diets containing different levels of crude glycerin especially with level of 6 %.

Statistical analysis:

Data were subjected to a one-way analysis using analysis of variance as described in the SAS programme **(SAS® institute, 1997).** Variables having significant differences were compared using Duncan's Multiple Range Test **(Duncan, 1955**).

RESULTS AND DISCUSSION

Chemical analysis of crude glycerin:

The analysis of crude glycerin was 84.65% glycerol, 10.17% water, 3.41% Na, and 3,445 kcal/kg of gross energy. Apparent ME of glycerin was determined as 3312

kcal/kg. AME of crude glycerin represent 96% of its gross energy, this results is in agreement with the finding of **Dozier *et al.* (2008)** who found that apparent metabolizable energy of crude glycerin for broiler chickens is 3434 kcal/kg about 95% of its gross energy.

Broiler chick performance:

The effects of glycerin on broiler chick performance are shown in Table 5. Results showed that at 14 days of age, the birds fed the diets with 4, 6 and 8% glycerin were significantly heavier than birds fed the basal diet without glycerin. No significant differences in average values of body weight or body weight gain were seen at 28 and 42 days of age between birds fed diets with different levels of glycerin. However, using 6% crude glycerin in broiler dies recorded heaviest body weight compared to control or the other treatments during different periods, followed by 8% glycerin. There were no significant differences on feed intake or feed conversion ratio between groups. Birds fed diets with 8% glycerin had highest feed consumption compared to those fed the control diet or the other treatments. The higher feed intake could be due to the improved consistency of the diets containing glycerol or the sweet taste of glycerin, it can increase feed intake and be efficiently absorbed in the animals gut **(Min *et al*., 2010)**. Feed conversion value at 28 and 42 days or overall period was the best for birds fed the diet with 6% crude glycerin. These results are in agreement with. **Lin *et al*. (1976), Lessard *et al.* (1993)**, **Simon (1996), Simon *et al.* (1996** and **1997), Cerrate *et al*. (2006), Min *et al*. (2008)** and **Dozier *et al.* (2008)** who found that the crude glycerin content of the rations did not affect body weight gain or feed conversion ratio. Also, they showed that using 5 or10% crude glycerol in broiler diets instead of corn starch had no adverse effects**.**

Nutrients digestibility:

Effect of crude glycerin level on nutrients digestibility are presented in Table (6). Data showed that crude glycerin had no significant effect on digestibility coefficient of all nutrients.

Carcass characteristics:

The effects of experimental treatments on carcass characteristics are presented in Table 7. Birds fed diets with glycerin did not differ significantly from birds fed the control diet for dressing percentage or the percents of internal organs or immune organs weights. These results are in agreement with **Lessard *et al.* (1993**), **Cerrate *et al.* (2006)** and **Min *et al.* (2008)** who indicated that there was no significant effect due to the addition of 2.5 or 5% glycerin on dressing percentage or yield of various carcass parts.

Blood constituents:

The effect of different levels of crude glycerin on blood constituents are shown in Table 8. Crude glycerin supplementation had no significant ($P < 0.05$) effect on average values of liver function (as measured by alkaline phosphatase (Alp), ALT and AST), total protein, albumin, globulin, A/G ratio, total lipids, triglycerides (T.G), total cholesterol, HDL cholesterol, uric acid, urea, glucose or kidney function (as measured by creatinine level). While, there were significant differences in the average values of LDL cholesterol.

Economical efficiency (EEf):

The final body weight and feeding cost are generally among the most important factors involved in achievement of maximum efficiency values of meat production. The economical efficiency of the different formulated diets as affected by different treatments are shown in Table 9. Results

In conclusion, the results of this experiment indicated that crude glycerin can be effectively used in broiler diets at levels of 6 or 8% of the diet without adverse effect on growth performance or meat quality of broiler chicks. Crude glycerin may play a role in the poultry industry by supplying energy at a more cost effective price than competing energy ingredients. However, a shadow-pricing exercise is necessary to ascertain whether glycerol can be economically included in current diets**.**

Table (1): Characterization of the crude glycerin fed to broiler chicks (on fed basis).

Item	**Value**
Total glycerol %	84.65
pH	8.00
Moisture %	10.17
Ash %	8.25
Sodium %	3.41
Potassium %	0.18
Lead, ppm	5.00
Gross energy Kcal/kg	3445
Metabolizable energy kcal/kg	3312

Table (2): Ingredient and calculated analysis of the starter diets during 7-14 d.

Ingredients	Diets				
	0(Cont.)	**2%**	**4%**	**6%**	**8%**
Yellow corn	54.13	51.84	49.79	47.32	45.29
Crude glycerol	-	2.00	4.00	6.00	8.00
Soybean meal (44%)	34.00	34.41	34.30	35.10	34.30
Corn gluten meal (60%)	3.00	3.00	3.35	3.10	4.00
Vegetable oil	4.30	4.35	4.22	4.31	4.15
Lime stone	1.25	1.25	1.31	1.33	1.38
Di calcium phos.	1.93	1.93	1.97	1.95	1.98
Vit.&Min. Premix*	0.30	0.30	0.30	0.30	0.30
DL-Methionin	0.26	0.26	0.26	0.27	0.26
L-Lysine-HCl	0.33	0.33	0.33	0.32	0.34
Nacl	0.50	0.33	0.17	-	-
Total	100	100	100	100	100
Calculated analysis**					
CP %	22.00	22.00	22.00	22.00	22.00
M. E. Kcal/kg	3086	3086	3086	3086	3086
Ca %	1.00	1.00	1.00	1.00	1.00
P. Avail. %	0.50	0.50	0.50	0.50	0.50
Lys. %	1.35	1.35	1.35	1.35	1.35
Meth. %	0.61	0.61	0.61	0.61	0.61
Meth +Cys %	0.97	0.97	0.97	0.97	0.97
Na	0.21	0.21	0.21	0.21	0.28
Price/ Ton (L.E)	2430	2420	2420	2415	2415

*Vit. & Min. Premix at 0.3% of the diet supplies the following per kg of the diet: Vit. A: 12000 IU; Vit. D_3 2000 IU; Vit. E: 40 mg; Vit. K_3 4 mg; Vit. B_1 3 mg; Vit. B_2 6 mg; Vit. B_6 4 mg; Vit. B_{12} .03 mg; Niacin 30 mg; Pantothenic acid 12 mg; folic acid 1.5 mg; Biotin .08 mg; Choline chloride 700 mg; Mn 10 mg; Cu 10 mg; Fe 40 mg; Zn 70 mg; Se .2 mg; I 1.5 mg; Co .25 mg; and $CaCo_3$ 3000 mg.
** According to **NRC (1994)**

Table (3): Ingredient and calculated analysis of the grower diets during 14-28 d.

Ingredients	diets				
	0(Cont.)	**2%**	**4%**	**6%**	**8%**
Yellow corn	62.27	60.19	58.40	56.0	52.85
Crude glycerol	---	2.00	4.00	6.00	8.00
Soybean meal (44%)	25.45	25.60	25.20	25.80	27.10
Corn gluten meal (60%)	4.80	5.00	5.50	5.43	5.00
Vegetable oil	3.43	3.35	3.16	3.21	3.51
Lime stone	1.12	1.13	1.14	1.13	1.13
Di calcium phos.	1.76	1.75	1.75	1.76	1.76
Vit.&Min. Premix*	0.30	0.30	0.30	0.30	0.30
DL-Methionin	0.11	0.11	0.11	0.11	0.12
L-Lysine-HCl	0.26	0.25	0.27	0.26	0.23
Nacl	0.50	0.32	0.17	-	-
Total	100	100	100	100	100
Calculated analysis**					
CP %	20.00	20.00	20.00	20.00	20.00
M. E. Kcal/kg	3150	3150	3150	3150	3150
Ca %	0.90	0.90	0.90	0.90	0.90
P. Avail. %	0.45	0.45	0.45	0.45	0.45
Lys. %	1.10	1.10	1.10	1.10	1.10
Meth. %	0.45	0.45	0.46	0.45	0.46
Meth +Cys %	0.79	0.79	0.79	0.79	0.79
Na	0.21	0.21	0.21	0.21	0.28
Price/ Ton (L.E)	2325	2315	2315	2305	2305

*Vit. & Min. Premix at 0.3% of the diet supplies the following per kg of the diet: Vit. A: 12000 IU; Vit. D_3 2000 IU; Vit. E: 40 mg; Vit. K_3 4 mg; Vit. B_1 3 mg; Vit. B_2 6 mg; Vit. B_6 4 mg; Vit. B_{12} .03 mg; Niacin 30 mg; Pantothenic acid 12 mg; folic acid 1.5 mg; Biotin .08 mg; Choline chloride 700 mg; Mn 10 mg; Cu 10 mg; Fe 40 mg; Zn 70 mg; Se .2 mg; I 1.5 mg; Co .25 mg; and $CaCo_3$ 3000 mg .
** According to **NRC (1994)**

Table (4): Ingredient and calculated analysis of the finisher diets during 28-42 d.

Ingredients	Diets				
	0(Cont.)	**2%**	**4%**	**6%**	**8%**
Yellow corn	67.42	65.44	61.87	59.82	57.41
Crude glycerol	-	2.00	4.00	6.00	8.00
Soybean meal (44%)	21.5	21.66	24.14	24.17	24.27
Corn gluten meal (60%)	3.70	3.75	2.56	2.81	3.10
Vegetable oil	3.44	3.38	3.88	3.80	3.82
Lime stone	1.09	1.10	1.08	1.08	1.08
Di calcium phos.	1.65	1.63	1.64	1.65	1.65
Vit.&Min. Premix*	0.30	0.3	0.3	0.3	0.3
DL-Methionin	0.13	0.14	0.15	0.15	0.15
L-Lysine-HCl	0.27	0.27	0.22	0.22	0.22
Nacl	0.50	0.33	0.16	-	-
Total	100	100	100	100	100
Calculated analysis**					
CP %	18.00	18.00	18.00	18.00	18.00
M. E. Kcal/kg	3196	3196	3196	3196	3196
Ca %	0.85	0.85	0.85	0.85	0.85
P. Avail. %	0.42	0.42	0.42	0.42	0.42
Lys. %	1.01	1.01	1.01	1.01	1.01
Meth. %	0.44	0.44	0.45	0.45	0.45
Meth +Cys %	0.75	0.75	0.75	0.75	0.75
Na	0.21	0.21	0.21	0.21	0.28
Price/ Ton (L.E)	2275	2270	2260	2255	2255

*Vit. & Min. Premix at 0.3% of the diet supplies the following per kg of the diet: Vit. A: 12000 IU; Vit. D_3 2000 IU; Vit. E: 40 mg; Vit. K_3 4 mg; Vit. B_1 3 mg; Vit. B_2 6 mg; Vit. B_6 4 mg; Vit. B_{12} .03 mg; Niacin 30 mg; Pantothenic acid 12 mg; folic acid 1.5 mg; Biotin .08 mg; Choline chloride 700 mg; Mn 10 mg; Cu 10 mg; Fe 40 mg; Zn 70 mg; Se .2 mg; I 1.5 mg; Co .25 mg; and $CaCo_3$ 3000 mg .

** According to **NRC (1994)**

Table (5): Effect of experimental treatments on body weight, body weight gain, feed intake and feed conversion.

Item	Crude glycerin level (%)						
	0 (Cont.)	2%	4%	6%	8%	MSE	P value
Starter period (7 -14 d)							
Body weight (g) at 14 d	307^{c}	322^{bc}	335^{ab}	336^{ab}	339^{a}	5	0.01
Body weight gain (g)	202^{c}	217^{bc}	230^{ab}	232^{ab}	235^{a}	5	0.01
Feed intake (g)	278	285	291	302	308	8	0.10
Feed conversion	1.38	1.31	1.26	1.31	1.31	0.02	0.08
Grower period (14 – 28d)							
Body weight (g) at 28 d	1177	1174	1183	1218	1210	13	0.11
Body weight gain (g)	870	852	848	881	870	18	0.26
Feed intake (g)	1473	1458	1433	1474	1462	29	0.73
Feed conversion	1.69	1.71	1.69	1.67	1.68	0.13	0.64
Finisher period (28 – 42 d)							
Body weight (g) at 42 d	2148	2136	2160	2279	2240	40	0.11
Body weight gain (g)	971	962	977	1061	1030	36	0.64
Feed intake (g)	2152	2119	2109	2147	2216	54	0.75
Feed conversion	2.22	2.20	2.16	2.02	2.15	0.12	0.77
Overall period (7 – 42 d)							
Body weight gain (g)	2043	2031	2055	2174	2135	40	0.11
Feed intake (g)	3903	3862	3832	3923	3986	77	0.36
Feed conversion	1.91	1.90	1.87	1.80	1.87	0.05	0.39

a, b, c… means in the same row within each factor with different superscripts are significantly different ($P \leq 0.05$)

Table (6). Effect of experimental treatments on nutrients digestion coefficients.

	Crude glycerin level (%)						
Item	**0(Cont.)**	**2**	**4**	**6**	**8**	**MSE**	**P value**
DM%	80.26	80.44	82.46	79.92	81.17	1.75	0.85
OM%	82.23	82.05	83.54	81.44	82.95	1.63	0.90
CP%	90.88	90.55	92.23	91.69	93.11	1.02	0.44
EE%	84.38	84.65	88.33	87.91	88.64	1.46	0.16
NFE%	85.28	85.60	85.42	82.59	84.22	1.56	0.64
CF%	25.80	29.71	29.95	25.12	28.26	5.29	0.95

Table (7): Effect of experimental treatments on carcass characteristics.

	Crude glycerin level (%)						
Item	**0 (Cont.)**	2	4	6	8	MSE	P value
Dressing%	69.36	67.09	71.45	68.49	68.27	1.69	0.49
Liver %	2.31	2.72	2.38	2.24	2.20	0.17	0.30
Abd. fat pad %	2.00	2.07	1.97	2.58	1.74	0.28	0.35
Spleen%	0.14	0.19	0.14	0.15	0.16	0.03	0.67
Thymus%	0.59	0.40	0.51	0.58	0.47	0.08	0.4
Bursa%	0.14	0.12	0.13	0.10	0.12	0.03	0.98
Gizzard%	1.90	2.00	1.97	1.98	2.06	0.10	0.85
Heart%	0.57	0.54	0.54	0.58	0.56	0.04	0.97

Table (8): Effect of experimental treatments on blood plasma constituents.

	Crude glycerin level (%)						
Item	**0(Cont**	2	4	6	8	MSE	P
ALT (U/l)	49.67	53.67	57.67	45.33	50.67	6.50	0.74
AST (U/l)	6.00	5.67	6.33	6.00	6.67	0.77	0.91
Alp (IU/l)	255.7	305.5	312.3	243.3	276.1	17.66	0.08
T. prot. (mg/dl)	3.47	3.67	3.30	3.39	4.05	0.23	0.24
Alb (mg/dl)	1.88	2.11	1.70	1.98	2.22	0.17	0.28
Glob (mg/dl)	1.59	1.56	1.60	1.41	1.83	0.13	0.30
A/G ratio	1.18	1.37	1.07	1.40	1.24	0.12	0.12
T.Lipids(mg/dl)	354.1	372.5	354.7	336.2	349.5	27.34	0.92
T. G (mg/dl)	125.7	129.9	107.2	111.4	119.5	14.15	0.77
T. chol. (mg/dl)	150.1	127.6	134.7	147.4	151.8	7.65	0.18
HDL chol.	52.5	47.3	52.9	47.6	53.6	2.24	0.72
LDL chol.	72.5^{ab}	54.3^{c}	60.3^{bc}	77.6^{a}	74.3^{ab}	4.81	0.03
Uric acid	4.19	5.69	4.73	4.05	4.47	0.55	0.31
Urea (mg/dl)	5.38	5.95	5.83	5.91	6.78	0.75	0.77
Creat. (mg/dl)	0.55	0.59	0.55	0.54	0.51	0.08	0.97
Glucose (mg/dl)	207.5	186.0	196.8	202.2	196.8	10.73	0.70

a, b, c… means in the same row within each factor with different superscripts are significantly different ($P \leq 0.05$)

Table (9): Effect of experimental treatments on economical efficiency.

Item	Crude glycerin level (%)				
	0 (Cont.)	2	4	6	8
Fixed cost (LE)[a]	7.00	7.00	7.00	7.00	7.00
Feed cost (LE)	9.00	8.87	8.79	8.97	9.11
Total cost (LE)	16.00	15.87	15.79	15.97	16.11
Body weight (kg)	2.15	2.14	2.16	2.28	2.24
Cost/ kg body weight(LE)	7.44	7.42	7.31	7.00	7.19
Total revenue (LE)[b]	19.35	19.26	19.44	20.52	20.16
Net revenue (LE)[c]	3.35	3.39	3.65	4.55	4.05
Economic efficiency (EEf)	0.209	0.214	0.231	0.285	0.251
Relative economic efficiency (REEf)[d]	100	102	111	136	120

a): Bird price and rearing cost.
b): Assuming that the selling price of one kilogram live body weight is 9.00 LE.
c): Net revenue per unit total cost.
d): Assuming that the treatment number 1 repersent the control 100 %.

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الملخص العربي

استخدام الجليسرين الخام في علائق كتاكيت اللحم

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اجريت هذه التجربة لتقييم مادة الجليسرين الخام كمادة علف غير تقليدية في تغذية بداري اللحم من خلال تقييم الجلسرين كميائيا . تم تقدير الطاقة الممثلة للجليسرين وتقييم مدي تأثير المستويات المتزايدة من الجليسرين الخام علي الأداء الإنتاجى وخواص الذبيحة ومعاملات الهضم في بداري التسمين. استخدم في تجربة النمو عدد 300 كتكوت اربرايكيرز عمر يوم و تم تغذيتها فى الأسبوع الأول علي عليقة باديء بدون جليسرين وفي بداية الأسبوع الثاني تم تقسيم الكتاكيت الي 5 معاملات كل معاملة تحتوي علي 3 مكررات. وكانت مستويات الجليسرين الخام 0، 2، 4، 6، 8% من العليقة. كان التحليل الكيميائي للجليسرين 84.65% جليسرول، 10.17% رطوبة، 3.41% صوديوم، 3445 كليو كالوري / كجم طاقة كلية، 3312 كيلو كالوري طاقة ممثلة.

أوضحت نتائج التجربة أنه لم يكن هناك اي فرق معنوي بين المعاملات المختلفة في وزن الجسم او معاملات التحويل الغذائي ، معاملات الهضم ، خواص الذبيحة ، قياسات الدم.سجل المستوى 6 % أفضل وزن جسم وزيادة فى وزن الجسم عند 42 يوم من العمر بينما سجل المستوى 2 % أقل النتائج .

أيضا أوضحت النتائج أن إضافة الجليسرين الخام إلى علائق دجاج اللحم أدى إلى تحسن فى قيم الكفاءة الإقتصادية لإنتاج اللحم وكان هذا واضحا خاصة مع مستوى 6 % .

من خلال هذه التجربة نستنتج انه يمكن استخدام الجليسرين الخام في علائق بداري التسمين حتي مستوي 8% دون اى تأثير عكسى علي معدل الأداء الإنتاجى أو معاملات الهضم أو خصائص الذبيحة أو الكفاءة الإقتصادية.