The use of sugar beet molasses in the diet of laying hens and its effect on the production performance

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ABSTRACT

This study was conducted at the laying hen farm of the Animal Production Department, College of Agriculture and Forestry, University of Mosul. Employing 216 local laying hens in the production stage from 21 weeks of age until the end of week 32. Sugar beet molasses was used in the experimental ration to ensure equal protein and energy content. The treatments were as follows:
T1: Control (Molasses-free), T2: Molasses 6% of the ration, T3: Molasses 8% of the ration, T4: Molasses 10% of the ration. The production indicator data were collected and statistically analyzed, with a significance test of the difference between means ($P \leq 0.05$).

The results were as follows: There were no significant differences between the 6% and 8% molasses treatments and the control group. However, a significant decrease in the number of eggs, egg mass, egg production rate, and feed consumption was observed when using 10% molasses. The weight of eggs produced decreased in the fourth treatment compared to the second and third treatments. A significant improvement in feed conversion ratio was observed in T2 and T3 compared with the control and T4. A significant increase in egg protein content and a significant decrease in egg cholesterol content were observed in the 8% and 10% treatments compared to the control. Methionine, glycine, cysteine, leucine, and phenylalanine content and Vitamins: A, B_2, B_6, and B_{12} were significantly increased in the molasses-use treatments compared to the control.

Keywords: Molasse, Feed energy, hens, Production performance, egg components.

Introduction

The increasing demand for unconventional and bio-based alternatives, recently introduced as feed ingredients, includes by-products from sugar beet processing, such as sugar beet molasses. Beet (Beta vulgaris) is a biennial crop in the spinach family. The term "sugar beet molasses" is used in scientific and industrial research to refer to molasses produced from sugar beet processing, distinguishing it from cane molasses. The Food and Agriculture Organization of the United Nations [19] reported that 183.5 million tons of sugar were produced globally between 2023 and 2024. Production is expected to reach 202 million tons in 2033. These processes produce molasses as a by-product.

Despite molasses' high sugar content, reprocessing it to extract additional sugar is not economically viable, as by-products such as beet pulp and molasses resulting from sugar refining

cause additional manufacturing costs added to the cost of sugar production [26]. Therefore, it has been used in ruminant animal feed and, more recently, in poultry feed as a low-cost, non-traditional material [12] , [18] , [19] and as an energy source [13], [24], [20]. It is also used as a fermenting agent in feed fermentation [19]. In addition, it is used as an appetite stimulant and binding agent in compound feeds, thereby reducing dust emissions [15].

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The English name for sugar beet molasses is (Beta vulgaris), a biennial cultivated plant in the spinach family. The term "sugar beet molasses" is used in scientific and industrial research to refer to molasses derived from sugar beets, distinguishing it from cane molasses. The dry matter content of molasses is approximately 80%. Molasses consists of approximately 50% sucrose, invert sugar, and raffinose. In comparison, the remaining 30% consists of organic matter and minerals such as potassium, sodium, calcium, magnesium, iron, and copper also contain several vitamins D, C, B, and A, minerals such as zinc, sodium, magnesium, potassium, calcium, iron, phosphorus, and bromine, amino acids, and fatty acids [15], [1], pectin breakdown products, lactic acid, and nitrogenous substances [1].

It also contains biotin and betaine non-protein nitrogenous compounds that enhance its nutritional value [14]. Molasses also contains substances that may result from Maillard reactions, such as melanins, phenols , and aromatic compounds [4]. Due to its composition and importance, interest in using molasses in ruminant diets remains strong [24], [20]. In recent years, there has been increased interest in the effects of new feed additives that improve digestibility and nutrient absorption, thereby enhancing the nutritional value of poultry products [2], [23]. In this study, molasses was used in the ration as a nutritional management approach to utilize an unconventional energy source, replacing some of the conventional energy in the diet with varying proportions of molasses.

Materials and Methods

The practical part of this study was carried out in the hall of the laying hen production field located in the Department of Animal Production - College of Agriculture and Forestry/University of Mosul for a period of twelve weeks from 1/8/2025 to 20/10/2025.

This study amid to determine the effect of using sugar beet molasses as an alternative non-traditional energy source on the productive performance of laying hens and on the internal components of the eggs produced.

Hens Used in the Experiment:

This study used 216 local Iraqi *Mezo* laying hens, 21 weeks . The production area (semi-closed house) had a plastic mesh floor divided into two pens, with a total area of 4.5 square meters. Water and feed were provided continuously. The amount of feed provided was 110 gm/hen/day for the duration of the study. The experiment included four treatments, and each treatment had three replicates, as follows:

T1: Standard ration and without molasses.
T2: Standard ration using 6% molasses.
T3: Standard ration using 8% molasses.
T4: Standard ration using 10% molasses.

The experimental rations, which included the standard control diet and the experimental treatments containing sugar beet molasses, were formulated based on the recommendations of the National Research Council [16] according to the nutritional requirements of laying hens for protein and energy, as shown in Table 1 , which shows the percentages of the ration’s components. The feed materials were mixed, then ground, and the diets were prepared at the animal production field feed’s mill.

Table 1 shows the feed materials included in the ration components.

Treatment / Feed Ingredient%	Control	Molasses 6%	Molasses 8%	Molasses 10%
Yellow corn	52	46	45	44.7
Feed wheat	15	14.5	12.9	10
Bran	6.1	6.1	6	6
Soybean meal	22	22.5	23	24
Oil	0.8	0.8	1	1.2
Premix	2.5	2.5	2.5	2.5
Limestone	1	1	1	1
Amino acids	0.6	0.6	0.6	0.6
Sugar beet molasses	0	6	8	10
Total	100	100	100	100
Chemical composition of feed components				
	17.155	17.056	17.068	17.137
Moisture (%)	10.486	10.371	10.318	10.315
Fat (%)	1.983	1.998	2.025	2.143
Fiber (%)	3.505	3.548	3.608	3.758
Ash (%)	6.368	6.147	5.952	5.382
Energy (kcal/kg)	3096	2897.0	3010	2996

* Premix composition per kg: 21% crude protein, 5000 kcal ME, 9% calcium, 14.5% available phosphorus, 5.6% sodium, iron 2400 mg, zinc 3680 mg, copper 480 mg, manganese 3200 mg, selenium 10 mg, iodine 48 mg, chlorine 6.5%, methionine 13.9%, methionine + cysteine 14.9%, lysine 9.6%, threonine 4.3%, valine 2.3%, vitamin A 480,000 IU, vitamin D3 220,000 IU, vitamin E 3000 mg, vitamin K3 138 mg, vitamin B1 138 mg, vitamin B2 280 mg, vitamin B3 1800 mg, vitamin B5 600 mg, vitamin B6 160 mg, vitamin B9 48 mg, vitamin B12 1000 mg, biotin 6900 mg, choline 16080 mg.

(**) The chemical composition was calculated based on the feed material analyses reported in NRC (1994).

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Molasses used in the study:

The type of molasses used is sugar beet molasses, purchased from the local market. It is a by-product of sugar production at sugar beet processing plants in southern Iraq. As shown in photo (1) and Table (2) shows the chemical composition of the sugar beet, which was chemically analyzed in the laboratory.

Table (2) Chemical composition of Molasses

Ingredient	Values
Dry matter %	72.30
Crude protein %	4.20
Crude fiber %	0.00
Crude fa t%	1.00
Ash %	10.30
ME (Kcal\kg)	2220
Linolenic acid (gm\kg)	1.20
Calcium (gm\kg)	6.60
Phosphorus (gm\kg)	0.50

Measures studied:

1- Production measures

- Average number of eggs produced (egg/hen/week)
-Average egg weight (gm/egg)
-Average egg mass produced (gm/hen/week)
-Egg production (H.D.P %)
-Average feed consumption (gm/hen/week)
-Egg feed conversion ratio (gm feed/g egg)

2- Chemical analysis of the egg's contents:

-Estimated protein percentage (%)
-Estimated fat percentage (%)
-Estimated total cholesterol
-Estimated carbohydrate percentage (%)
-Estimated amino acids
-Estimated some vitamins

The completely randomized design (C.R.D) was used to study the effect of the treatments, and the data were statistically analyzed using the ready-made statistical program [17]. Significance was tested under a probability level ($P \leq 0.05$) between the means according to the Duncan Test [18]

Results and discussion

1-Effect of using Molasses to layer hen ration on production traits

- Number of eggs (egg/hen/week)

Table (3) shows no significant differences ($p \leq 0.05$) in the fifth week between the molasses addition and control treatments when molasses was used in the diet at percentages of (0, 6, 8, 10)%. It is worth noting that the number of eggs produced decreased in the fourth treatment (10% molasses) compared to the second and third treatments (6 % and 8%) molasses, but did not differ significantly from the control treatment. However, the number of eggs in weeks (6, 7, 8, 9, 10, 11, 12) showed a significant decrease in the fourth treatment compared to the control, the second and third treatments, and also during the total period (1-12) weeks, reaching (4.87, 5.61, 5.89, 5.79) (eggs/hen/week), respectively. While these two treatments did not differ with the number of eggs in the control treatment and the fourth treatment, and these results agreed with [18],

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these results differed with [11] when 10% molasses was using to the ration of laying hens of the (Hy-line 36) breed raised in cages from the age of 28 weeks to 42 weeks, as he did not find significant differences. Also, [3] noted the absence of a significant effect of increasing dietary sugar beet molasses.

- weight of egg (gm/egg)

It was observed from Table (4) that there were no significant differences in the first week of the experiment between the control and the treatments using molasses, while the weight of the eggs from (the second week until the twelve week) increased significantly in the T2 (6% molasses) compared to the control, as well as with the two treatments (8, 10% molasses) during weeks (2, 3, 4, 5, 6, 7). In weeks (8, 9, 10, 11, 12), no significant differences were observed in the average weight of the eggs produced between the second, third, and fourth treatments compared to the control. It was noted that T4 was the least significant and numerically significant in weight. During the total period (21-32) , a significant increase observed the average egg weight in T2 was observed compared to T4. These two treatments, the second and fourth, did not differ significantly from the control and T3, and the weight of the eggs reached (56.78, 51.42, 52.38, 53.34) gm/egg, respectively.

These results were consistent with [8], as who did not show a significant effect on egg weight during production periods 14, 28, and 42 when molasses was added at 5% and 10% to the diet. These results differed from those of the researchers [25] and [6], as egg weight increased significantly when molasses was used in the diet.

- Mass of eggs produced (gm/hen/week)

Table 5 shows that in the first week there were significant differences between the molasses treatment and the control, but the T2 increased significantly compared to T4, whereas the third and fourth treatments did not differ significantly from the control. In the second week, the T2 increased significantly compared to the control and the T4, whereas T3 did not differ significantly from either of these –treatments. In the third and fourth weeks, the value of egg mass increased significantly in T2 and T3 compared to the control and T4.

As the weeks of production progressed, the second and third treatments did not differ significantly from the control in the average egg mass in weeks (5 to week 12). It was observed that the fourth treatment (10%) molasses decreased significantly compared to the control and with the two treatments using molasses at the percentages (6%, 8%).

The overall average egg mass produced over the entire period was also significantly lower in the fourth treatment than in the other treatments under study. The values for the control, second, third and fourth treatments were (294.00, 335.46, 312.15, 250.8) (hen /week) respectively.

It is evident here that the hens in the second and third treatments were able to produce several grams of egg mass, which was significantly equal to the egg mass produced by the control and mathematically superior to it as an overall average for the entire period during the twelve weeks. This indicates that the use of molasses at the ratios of 6 and 8% maintained the performance concerning the number of eggs (Table 3) and egg weight (Table 4), which was reflected in the average mass obtained, as these two ratios covered the percentage of energy required to produce this

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mass (grams) of eggs. However, we note that increasing the molasses content of the diet to 10% negatively affected this characteristic. This may be due to the flock contracting diarrhea as a result of raising this ratio,leading to the excretion of nutrients in a shorter time without benefiting from them .

The improvement in egg mass the fact that consuming molasses as a dietary supplement increases the production of short-chain fatty acids in the cecum [10], which is reflected in the mass produced from eggs.

-Egg production rate H.D.P.%:

Table 6 shows no significant differences ($p \leq 0.05$) in the first, second, and third weeks between the treatments. From the fourth to the twelfth weeks of production, a significant decrease in T4 was observed compared to the control and T2 and T3. However, it was noted that egg production in the hens of these two treatments did not differ significantly compared to egg production in the control treatment. Likewise, for the overall production period rate, it was also observed that the production rate in the T4 compared to the control and T2 and T3, reached (68.94, 79.87, 83.96, 80.53) % respectively.

The T2 and T3 yielded the same egg production as the control and maintained overall production throughout (21-32). This may be attributed to the fact that the energy provided by the molasses at 6% and 8% replace some of the energy that was largely supplied by the wheat. The decline in egg production in T4, compared to the other treatments, may be due to a decrease in the hens' egg-laying performance in the same treatment (Table 3). This result agrees with [26], who observed an improvement in egg production [5], They observed a significant improvement in egg production in the supplementary treatments with molasses compared to the control treatment.

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Table 3: Effect of using sugar beet molasses added to the ration of hens on the number of eggs. (egg/hen/week).

Treatments Age of hens\ week	Number of eggs produced (egg/hen/week)			
	T1Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
21	3.62 a 0.33 ±	3.68 a 0.4 ±	3.59 a 0.45 ±	3.45 a 0.51 ±
22	4.56 a 0.23 ±	4.65 a 0.41 ±	4.55 a 0.21 ±	4.41 a 0.16 ±
23	4.61 a 0.21 ±	4.69 a 0.35 ±	4.48 a 0.22 ±	4.60 a 0.38 ±
24	5.11 a 0.45 ±	5.36 a 0.15 ±	5.29 a 0.39 ±	4.71 a 0.41±
25	5.8 ab 0.44 ±	6.3 a 0.51 ±	6.29 a 0.61 ±	5.13 b 0.41 ±
26	6.28 a 0.55 ±	6.46 a 0.34 ±	6.32 a 0.52 ±	5.40 b 0.39 ±
27	6.31 a 0.57 ±	6.62 a 0.42 ±	6.58 a 0.50 ±	5.29 b 0.52 ±
28	6.35 a 0.44 ±	6.67 a 0.45 ±	6.59 a 0.37 ±	5.22 b 0.56 ±
29	6.29 a 0.55 ±	6.63 a 0.38 ±	6.53 a 0.52 ±	5.18 b 0.41 ±
30	6.27 a 0.41 ±	6.60 a 0.33 ±	6.51 a 0.32 ±	5.12 b 0.15 ±
31	6.11 a 0.57 ±	6.55 a 0.44 ±	6.44 a 0.43±	5.00 b 0.22 ±
32	6.02 a 0.39 ±	6.51 a 0.50 ±	6.32 a 0.48 ±	5.00 b 0.44 ±
Average for the entire period	5.61 a 0.49 ±	5.89 a 0.43 ±	5.79 a 0.74 ±	4.87b ± 0.38

Different letters in the same row indicate significant differences between the means below the level ($P \leq 0.05$) (mean ± S.E)

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Table 4: Effect of using sugar beet molasses added to the ration of hens on the weight of eggs. (gm/egg).

Treatments / Age of hens\ week	Weight of eggs produced (gm/egg)			
	T1Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
21	50.28 a 0.54 ±	55.42 a 0.43 ±	51.60 a 0.51 ±	49.20 a 0.34 ±
22	50.00 b 0.43 ±	55.04 a 0.23 ±	52.25 b 0.60 ±	50.27 b 0.46 ±
23	50.73 b 0.44 ±	55.84 a 0.39 ±	52.95 b 0.35 ±	51.17 b 0.45 ±
24	51.50 b 0.43 ±	55.90 a 0.60 ±	52.72 b 0.71 ±	51.56 b 0.44 ±
25	51.91 b 0.39 ±	56.60 a 0.29 ±	52.81 b 0.47 ±	50.70 b 0.47 ±
26	51.80 b 0.44 ±	57.10 a 0.63 ±	53.11 b 0.48 ±	51.41 b 0.66±
27	53.52 b 0.73 ±	57.33 a 0.48 ±	53.60 b 0.64 ±	51.63 b 0.55 ±
28	54.38 ab 0.53 ±	57.66 a 0.37 ±	54.64 ab 0.66 ±	52.11 b 0.33 ±
29	53.51 ab 0.34 ±	57.66 a 0.44 ±	54.00 ab 0.37 ±	52.16 b 0.28 ±
30	53.35 ab 0.51 ±	57.44 a 0.39 ±	54.14 ab 0.33 ±	52.18 b 0.35 ±
31	53.73 ab 0.41 ±	57.61 a 0.64 ±	54.12 ab 0.54 ±	52.22 b 0.55 ±
32	53.91 ab 0.49 ±	57.72 a 0.50 ±	54.16 ab 0.33 ±	52.43 b 0.38 ±
Average for the entire period	52.38 ab 0.34 ±	56.78a 0.43 ±	53.34 ab 0.36 ±	51.42 b 0.44 ±

Different letters in the same row indicate significant differences between the means below the level ($P \leq 0.05$) (mean ± S.E)

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Table 5 : Effect of using sugar beet molasses added to the ration of hens on the mass of eggs. (egg/hen/week).

Treatments / Age of hens\ week	Mass of eggs produced (gm/hen/week)			
	T1 Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
21	182.01 ab ± 7.11	203.95 a 8.22 ±	185.24 ab 6.9 ±	169.74 b 9.11 ±
22	228.00 b ± 11.43	255.94 a 9.55 ±	237.74 ab 12.35 ±	216.97 b 10.50 ±
23	223.86 b 11.57 ±	261.89 a 8.98 ±	256.28 a 9.55 ±	235.38 b ± 12.23
24	262.65 b ± 9.35	299.62 a 8.12 ±	312.11 a ± 9.57	242.85 b ± 10.12
25	301.08 a 14.01 ±	356.58 a 12.34±	332.2 a 9.90 ±	260.09 b ± 10.12
26	325.30 a 9.24 ±	368.87 a ± 11.12	335.65 a 8.17 ±	278.8 b 10.00 ±
27	337.71 a ± 12.00	379.52 a ± 12.00	337.16 a ± 9.99	273.12 b ± 8.89
28	339.88 a ± 11.40	384.59 a ± 13.00	353.49 a 11.67 ±	272.01 b ± 9.77
29	336.58 a 9.66±	382.29 a 10.90 ±	352.62 a ± 11.00	270.19 b 8.35 ±
30	334.50 a ± 9.19	379.10 a ± 12.88	352.45 a ± 9.78	267.16 b ± 8.11
31	328.29 a 9.35 ±	377.35 a 11.56 ±	348.53 a ± 11.12	261.1 b ± 8.11
32	324.54 a ± 9.89	375.76 a ± 11.34	342.30 a ± 12.45	262.15 b ± 9.00
Average for the entire period	294.00a 8.11 ±	335.46 a ± 12.33	312.15 a ± 11.67	250.8 b 9.08 ±

Different letters in the same row indicate significant differences between the means below the level ($P \leq 0.05$) (mean ± S.E)

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Table 6 : Effect of using sugar beet molasses added to the ration of hens on the H.D.P%

Treatments / Age of hens\ week	H.D.P %			
	T1 Control Molasses 0.0%	**T2 Molasses 6%**	**T3 Molasses 8%**	**T4 Molasses 10%**
21	51.71 a ± 11.06	52.57 a ± 9.89	40.29 a ± 11.44	40.93 a ± 9.57
22	65.14 a ± 13.6	66.43 a ± 9.67	64.43 a ± 8.98	62.86 a ± 10.77
23	64.29 a ± 9.55	64.29 a ± 8.91	64.00 a ± 12.17	65.71 a ±12.10
24	73.86 a ± 8.67	76.57 a ± 10.22	75.57 a ± 10.77	67.29 b ± 13.90
25	82.86 a ± 12.88	90.00 a ± 10.12	89.86 a ± 12.45	73.29 b ± 13.44
26	89.71 a ± 9.00	92.29 a ± 9.77	90.29 a ± 10.73	77.14 b ± 10.33
27	89.14 a ± 8.25	94.57 a ± 9.34	94.00 a ± 10.13	75.57 b ± 9.78
28	89.29 a ± 8.56	95.29 a ± 11.23	94.14 a ± 9.13	74.57 b ± 12.00
29	89.14 a ± 8.23	94.71 a ± 12.15	93.29 a ± 9.09	74.00 b ± 6.15
30	89.57 a ± 9.87	94.29 a ± 11.13	93.00 a ± 7.56	73.14 b ± 8.67
31	87.29 a ± 8.14	93.57 a ± 10.24	93.57 a ± 9.13	71.43 b ± 8.68
32	86.42 a ± 9.11	93.00 a ± 10.45	92.00 a ± 10.34	71.43 b ± 6.17
Average for the entire period	ab 79.87 ± 8.69	83.96 a ± 8.24	80.53 a ± 12.33	68.94 b ± 9.29

Different letters in the same row indicate significant differences between the means below the level (P≤0.05) mean ± S.E)

Feed consumption rate (gm/hen/week):

Table (7) shows that no significant differences (p≤0.05) were observed between the treatments in the first, second and fourth weeks. In contrast, it was observed that feed consumption in the third week decreased significantly in the treatments using molasses in the rations compared to the control, and this significant decrease in feed consumption continued for the third and fourth treatments until the end of the study period, compared to the control, the T2.

Similarly, over the entire rearing period, the T4 (10% concentration) significantly decreased feed consumption compared to the control, second, and third treatments, reaching

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(593.42, 660.87, 641.35, and 631.59) g/chicken / week, respectively, while the presence of molasses in the feed increases palatability in ruminants due to improved taste, the opposite may occur in poultry. Poultry are affected by the high viscosity of molasses, making the feed heavier and more difficult to swallow. Furthermore, the increased moisture and viscosity resulting from adding more than 5% molasses causes the feed to clump, reducing the bird's appetite. Additionally, the fermentation of feed materials in the presence of sugars causes bloating of the digestive tract, leading to early satiety and thus reducing feed consumption. [17] noted that feed consumption decreases with increasing molasses content in drinking water.

-Feed Conversion Ratio (gm feed/gm egg)

Table 8 shows significant differences between the molasses utilization treatments in the diet and the control. The feed conversion ratio improved significantly in T2 (6% molasses) compared to the control and the T3 and T4 (8% and 10% molasses) during the first and second weeks. As the rearing period progressed, it was observed that the feed conversion ratio improved significantly in T2.

During weeks three to twelve, there was a significant decrease in the feed Conversion Ratio compared to the control and T4 . The T3 did not differ from the control and the other treatments under study.

Similarly, for the entire period (21-32 weeks), the feed conversion ratio decreased significantly in the T2 and T3 compared to the control and T4, reaching values of (1.88, 1.99, 2.21, 2.34) g feed/g egg, respectively.

The use of molasses at 6% and 8% gave the ideal ratio of molasses, which increased the production of short-chain fatty acids [10]. Although some components of molasses do not directly affect poultry nutrition, they positively affect the growth of intestinal microbes [15] which is reflected in the utilization of feed components due to increased digestion processes and availability of nutrients, thus increasing the feed utilization rate [10], This is reflected in the increased assimilation of elements, which is represented by a reduction in the feed conversion ratio, The 10% molasses supplementation resulted in the worst feed conversion ratio, likely due to the bird’s developing diarrhea from the high molasses content. This led to rapid feed passage through the digestive tract, resulting in reduced digestion and absorption because the feed remained in the intestines for a shorter period. These findings are consistent with those of [5] and [6], who reported that the feed conversion ratio improved with the addition of molasses to the diet.

2- The effect of using beetroot molasses added to the egg-laying diet on egg components:

- Proteins, fats, cholesterol, and carbohydrates

Table 9 shows the effect of molasses use on egg protein, fat, cholesterol, and carbohydrate content. The protein percentage increased significantly in the 8% and 10% molasses-infused diets compared to the control, while it did not differ significantly in the 6% molasses-infused diet. The protein percentages were 15.23%, 15.41%, 13.88%, and 14.99%, respectively.

The fat and carbohydrate percentages in the egg content did not differ between the molasses-infused and control. The cholesterol content in the egg decreased significantly with increasing molasses content in the diet, reaching (220.6, 218.7, and 210.6) mg/100g for treatments with molasses content of 6%, 8%, and 10% in the diet, respectively, compared to the control treatment, which had a cholesterol content of (233.0) mg/100g. These results were consistent with [21], who stated that the two percentages of molasses use (5 and 10) % in the diet significantly reduced the percentage of cholesterol compared to the control (4.86, 3.12, 2.56) mg/g, as well as with [22], and differed with [19], who stated that the using of molasses did not have a significant effect on the components of the eggs produced during (28 weeks up to 40 weeks) of production compared to the control.

-The amino acids methionine, glycine, cysteine, leucine, and phenylalanine:

Table 10 showed significant differences (P≤0.05) between the treatments using molasses in the ration and the control. Methionine content in the egg increased significantly for molasses usage percentages in the ration (6, 8, 10), approximating that of the control, reaching (75.9, 83.9, 92.6, 63.6) ppm, respectively. Similarly, glycine increased significantly in the same treatments compared to control (184.5, 190.8, 197.8, 173.8) p.pm, respectively. Cysteine levels also increased dramatically with increasing molasses usage percentage in the rations, reaching (123.5, 130.6, 138.7, 117.4) p.pm for the aforementioned treatments, respectively. The amount of leucine in the egg content increased significantly in the third and fourth treatments compared to the control. In contrast, T2 did .

not differ significantly from the control; T3 and T4 , reached (433.5, 440.6, 402.6, 416.9) p.pm, respectively. Likewise, the amount of phenyl-alanine increased significantly in the T3 and T4 compared to the control. In contrast, T2 did not

differ significantly from the other treatments (162.5, 171.4, 140.9, 149.8) p.pm, respectively. These results are consistent with [24], where it was stated that the content of eggs increased significantly in amino acids.

-The vitamin:

Table 11 showed that significant differences (P≤0.05) were observed between the treatments using molasses in the ration and the control. Vitamin A, Vitamin B2, and Choline increased significantly in the egg content of the T3 and T4 compared to the control. The T3 did not differ significantly from the treatments mentioned (441.8, 451.6, 428.9, 432.5) International Units, (12.8, 14.9, 10.4, 11.5) ppm, respectively, and (264.8, 271.6, 246.8, 258.7) p.pm for the mentioned traits, respectively. Regarding vitamin B6, the T3 and T4 significantly increased compared to the control and T2, reaching (6.0, 6.9, 4.0, 4.9) p. pm, respectively. Likewise, there was the same significant effect of the treatments for using molasses about vitamin B12, and the values reached (0.60, 0.71, 0.79, 0.49) p.pm respectively.

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Table 7: Effect of using sugar beet molasses added to the ration of hens on feed consumption (gm/hen/week)

Treatments / Age of hens\ week	feed consumption (gm/hen/week)			
	T1 Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
21	a 327.82 ± 12.33	317.72 a 10.78 ±	316.12 a 9.45 ±	320.11 a 11.00 ±
22	417.24 a 14.45 ±	424.86 a 13.55 ±	422.69 a 14.23 ±	412.50 a 10.56 ±
23	491.12 a 12.34 ±	442.59 b 10.13 ±	456.17 b 11.09 ±	461.00 b 9.34 ±
24	559.44 a 10.23 ±	521.34 a 13.12 ±	546.92 a 10.67 ±	534.27 a 9.12 ±
25	665.39 a 11.23 ±	645.41 a 14.34 ±	617.89 b 16.33 ±	593.01 b 12.12 ±
26	728.68 a 9.78 ±	682.41 a 10.13 ±	641.09 b 16.09	644.03 b 18.67
27	736.21 a 10.34 ±	724.88 a 13.56 ±	660.83 b 12.05 ±	669.14 b 12.55 ±
28	788.52 a 9.88 ±	742.26 a 10.13 ±	749.40 a 9.78 ±	682.75 b 11.46 ±
29	790.96 a 13.14 ±	749.29 a 13.31 ±	751.08 a 10.17 ±	688.91 b 9.23
30	806.15 a 9.91 ±	799.90 a 12.56 ±	785.96 a 10.12±	699.96 b 10.34±
31	801.03 a 15.56±	818.85 a 11.44 ±	805.10 a 10.23 ±	702.36 b 11.67 ±
32	817.86 a 13.34 ±	826.67 a 14.13 ±	807.83 a 15.22±	713.05 b 11.29 ±
Average for the entire period	660.87 a 12.13 ±	641.35 a 10.15 ±	631.59 a 17.11 ±	593.424 b 10.12 ±

Different letters in the same row indicate significant differences (P≤0.05) (mean ± S.E)

Table 8: Effect of using sugar beet molasses added to the ration of hens on the feed conversion ratio (gm feed/gm egg mass)

Treatments / Age of hens\ week	Feed conversion ratio (gm feed/gm egg mass)			
	T1 Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
21	0.31 ± 1.8 a	0.41 ± 1.56 b	1.71± 0.05 a	1.89± 0.25 a
22	1.83± 0.44 a	1.66 ± 0.12 b	1.77± 0.08 a	1.90± 0.09 a
23	2.1± 0.08 a	1.69± 0.01 b	1.78 ± 0.05 ab	1.96± 0.09 a
24	2.13± 0.33 a	1.74 ± 0.34 b	1.750.18 ± ab	2.20± 0.05 a
25	2.21± 0.09 a	1.81± 0.16 b	1.860.38 ± ab	2.28± 0.07 a
26	2.24± 0.34 a	1.85± 0.07 b	1.91 ± 0.09 ab	2.310.31 ± a
27	2.18± 0.07 a	1.91± 0.09 b	1.96± 0.03 ab	2.45± 0.05 a
28	2.32± 0.27 a	1.93± 0.05 b	2.12 ± 0.06ab	2.51± 0.09 a
29	2.35 ± 0.04 a	1.96± 0.09 b	2.13± 0.08 ab	2.55± 0.07 a
30	2.41± 0.06 a	2.11± 0.18 b	2.23± 0.08 ab	2.62 ± 0.05 a
31	2.44± 0.07 a	2.17± 0.02 b	2.31± 0.09 ab	2.69± 0.05 a
32	2.52± 0.06 a	2.20± 0.11 b	2.36± 0.06 ab	2.72 ± 0.26 a
Average for the entire period	2.21± 0.05 a	1.88± 0.33 b	1.99± 0.08 b	2.34± 0.12 a

Different letters in the same row indicate significant differences (P≤0.05) (mean ± S.E)

Table 9: Effect of using sugar beet molasses added to the ration of hens on the Protein %, Fats% , Cholesterol gm/100mg, Carbohydrates % content of eggs.

Treatments / The components	Treatment			
	T1 Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses8%	T4 Molasses 10%
Protein %	13.88 ± 1.03 b	14.99 ± 0.88 ab	15.23 ±1.22 a	15.41± 1.09 a
Fats %	11.66± 1.34 a	12.02± 1.2 a	12.30 ± 1.13 a	12.74 ± 1.00 a
Cholesterol gm/100mg	233.0± 3.3 a	220.6± 4.34 b	218.7± 4.33 b	210.6± 3.11 b
Carbohydrates %	1.22 ±0.09 a	1.40± 0.05 a	1.53 ± 0.06 a	1.62 0.05 ± a

Different letters in the same row indicate significant differences (P≤0.05) (mean ± S.E)

Table 10: Effect of using sugar beet molasses added to the ration of hens on the amino acid content of eggs.

Treatment / The amino acid	The amino acid content of eggs			
	T1 Control Molasses 0.0%	T2 Molasses 6%	T3 Molasses 8%	T4 Molasses 10%
Methionine ppm	63.6± 3.11 b	75.9 ± 3.13a	83.9 ± 4.11a	92.6 ± 5.56 a
Glycine ppm	173.8± 7.5 b	184.5 ± 6.23a	190.8 ± 5.46 a	197.8± 3.77 a
Cysteine ppm	117.4± 4.11b	123.5± 7.45 a	130.6± 6.54a	138.7± 4.77 a
Leucine ppm	402.6 ± 7.47b	416.9± 8.23ab	433± 6.81a	440.6± 7.11 a
Phenylalanine ppm	140.9± 11.3b	149.± 9.77 ab	162.5± 7.91a	171.4± 9.00 a

Different letters in the same row indicate significant differences (P≤0.05), (mean ± S.E)

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Table 11: Effect of using sugar beet molasses added to the ration of hens on the vitamin content of eggs.

Treatment / The vitamins	The vitamins content of eggs			
	T4 Molasses 10%	**T3 Molasses 8%**	**T2 Molasses 6%**	**T1 Control Molasses 0.0%**
Vit. A (IU)	428.9± 9.09 b	432.5± 7.24ab	441.8± 5.76a	451.6± 8.76 a
Vit. B2 (ppm)	10.4± 1.66 b	11.5 1.12 ± ab	12.8 ± 1.09 a	14.9± 1.24 a
Vit. B6 (ppm)	4.0± 0.89b	4.9 ± 0.33 b	6.0 ± 0.81a	6.9± 0.19 a
Vit. B12 (ppm)	0.49± 0.01 c	0.60 ± 0.04 b	0.71± 0.08 a	0.79± 0.03 a
Colin (ppm)	246.8± 11.06 b	258.7± 9.11ab	264.8± 9.23 a	271.6± 8.22 a

Different letters in the same row indicate significant differences (P≤0.05), (mean ± S.E)

Conclusion

This study demonstrated the potential of using sugar beet molasses as an unconventional energy source by replacing wheat as a significant component of the total energy in feed rations. This contributes to the use of readily available, locally sourced feed alternatives, thereby reducing the use of grains in feed rations and their competition with human consumption. This represents a valuable management technique and a potentially viable nutritional measure. Most production characteristics, such as egg weight, egg mass, and daily production rate, remained unaffected, with an improvement in feed conversion ratio at the two percentages used (6,8)%. However, a higher percentage of molasses (10)% had a negative impact on the production.

Furthermore, this study showed that incorporating molasses into the egg-laying diet significantly increased the amino acid and vitamin content of the egg and contributed to lowering cholesterol levels. This makes it a valuable nutritional tool for addressing health issues such as vitamin and amino acid deficiencies. It can also be considered a promising method for producing processed eggs for pharmaceutical use.

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