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Consequences of new approach in production system of commercial layer (Isa Brown) in Iraqi Kurdistan region

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Abstract. This study was taken as a first attempt to investigate the effect of new production system of commercial layer with special emphasis on organic technique. A total 360 one-day-old Isa Brown chicks were obtained from Evan hatchery-Erbil. The birds assigned into 18 indoor pens (2×2 m) for the first 18 weeks. Each pen represented a replicate with 20 chicks. At beginning, birds assigned to the same condition and fed their daily requirements according to Isa Brown guide (2018). The feed as commercial and organic feed. Birds were randomly divided into six treatment groups of three replicates. The treatments were as follows; first treatment (T1): as control birds fed their full requirements according to Isa Brown layers guide (2018), fed commercial feed, reared indoor house, second treatment (T2): birds fed organic feed full requirements according to Isa Brown layers (2018) reared indoor house, third treatment (T3): birds fed 75% of full requirements commercial feed + pasture indoor and outdoor, fourth treatment (T4): birds fed 75% full requirement organic feed + pasture indoor and outdoor, fifth treatment (T5): birds fed full requirements according to Isa Brown layers guide (2018) commercial feed + pasture indoor and outdoor housed, sixth treatment (T6): birds fed full requirements according to Isa Brown layers guide (2018) organic feed + pasture indoor and outdoor housed. At the beginning of week 19, birds had free access to pasture through a hole from indoor to the outdoor except control (T1) and (T2). The outdoor area measured 2 × 10 m (1 m²/bird) for each pen and separated by fence. The outdoor area designed to provide bird a natural behavior and covered with alfalfa (Medicago sativa). The results of this study indicates that commercial strain had higher ($P < 0.01$) haugh unit (73.08), the highest Haugh unit was recorded in T1 72.89. Birds in T2 of commercial strain had higher ($P < 0.01$) total UFA content 71.42, total n-3 in T4 was 1.80. n-6 was higher in T2 21.48 comparing to the other treatments. Significant differences ($p \leq 0.01$) for amino acids in commercial eggs found among treatments and T6 content higher percentage of all amino acids. The overall means of profit from only eggs was 197,403 ID and for eggs with hen was 282,208 ID. Significant differences found among treatments for sensory evaluation of commercial eggs. T6 had higher ($P < 0.01$) score of overall acceptances for both commercial eggs.

1. Introduction

Nowadays organic egg and meat are the terms mostly used in many countries. The system producing such commodity called as "organic", "free range" or "cage-free", barn-roaming or non-cage system. In such systems, hens are housed to a similar standard as the barn or backyard. The nutritional quality of eggs and meat produced in this system is superior to that of eggs produced in the cages (1). Under free-range or organic systems, birds have access to an outside area promoting foraging, feeds election, and activity and thus improving the welfare of the birds (2). In Kurdistan as well as in Iraq the free range or back yard chickens are reared since long time ago. So to enhance



such system of poultry production to contribute in self-sufficient eggs production of organic eggs and meat are vital issue.

Commercial poultry husbandry has been changing since consumers demand poultry products changed, and this lead to increase development in the poultry industry (3). In the last two decades, consumers around the world are more concern about raising birds, regarding the use of synthetic chemicals, antibiotics and animal welfare. Free-range and organic chicken meat and egg are those products preferred by many consumers because they believe the quality and sensory of these products are superior (1).

Previous studies have shown that alternative rearing systems can affect certain performance characteristics and egg nutritional composition (4;5). A significant rearing system by genotype interaction was also found in another study pertaining to performance and egg quality (5). Although the effect of organic rearing systems on performance traits and egg quality has been investigated by an increasing number of studies in recent years 6; 7; 8; 9; 10; 11; 12).

The objective of our studies were to investigate the effects of production systems (conventional and organic) on commercial layer strains by applying conventional and organic systems, laying performance, egg quality, and sensory evaluation and finally , evaluating the economic efficiency of both systems.

2. Material and Methods

2.1 Location and Time

This study was conducted at the College of Agricultural Engineering Sciences –University of Salahaddin- Erbil at (Grdarasha farm), egg production started from 9 April 2017 until 9 April 2018. To best of our knowledge, these studies were the first organic production system that conducted in Kurdistan Region of Iraq and Iraq as whole.

2.2 Experimental Design

A total 360 one-day-old Isa Brown chicks were obtained from Evan hatchery-Erbil. The birds assigned into 18 indoor pens (2×2 m) for the first 18 weeks. Each pen represented a replicate with 20 chicks. At beginning, birds assigned to the same condition and fed their daily requirements according to Isa Brown guide (2016). The fed as commercial and organic feed. Birds were randomly divided into six treatment groups of three replicates. the treatments were as follows; first treatment (T1): as control birds fed their full requirements according to Isa Brown layers guide (2018), fed commercial feed, reared indoor house, second treatment (T2): birds fed organic feed full requirements according to Isa Brown layers guide (2018) reared indoor house, third treatment (T3): birds fed 75% of full requirements commercial feed + pasture indoor and outdoor , fourth treatment (T4): birds fed 75% full requirement organic feed + pasture indoor and outdoor, fifth treatment (T5): birds fed full requirements according to Isa Brown layers guide (2018) commercial feed + pasture indoor and outdoor housed , sixth treatment (T6): birds fed full requirements according to Isa Brown layers guide (2018) organic feed + pasture indoor and outdoor housed. At the beginning of week 19, birds had free access to pasture through a hole from indoor to the outdoor except control (T1) and (T2). The outdoor area measured 2 × 10 m (1 m²/bird) for each pen and separated by fence. The outdoor area designed to provide bird a natural behavior and covered with alfalfa (*Medicagosativa*).

2.3 Feeding System of Hen

The feeding, management and lighting programs used in this study were followed Isa Brown management guide (Isa Brown management handbook 2018). Water provided ad libitum. Organic feed provided from DSA Agrifood Products kirikkale- Turkey ISO 22000(2005) as show in (Table.1)

Table 1. Feed composition and nutrient content of egg production period experiment (organic and commercial)

Ingredients %	Commercial	Ingredients %	Organic
Corn	400	Corn	600.0
Soybean meal %48	250	Soybean meal %48	200.0
Wheat	190	Sunflower	130.0
Wheat bran	90	Ray flower	5.0
Limestone	57.0	Limestone	50.0
Vitamins-Minerals*	1.0	Vitamins-Minerals	1.0
Dicalcium phosphate	9.0	Dicalcium phosphate	10.0
Methionine	0.5	Pepper	3.0
Lysine %	0.5	Salt	1.0
Antioxidant	1.0		
Salt	1.0		
Calculated nutrient content (%)			
Protein	19.00	Protein	19.86
Metabolizable energy (kcal/kg)	2660.00	Metabolizable energy (kcal/kg)	2625.0

2.4 Haugh Unit

Hough unit was calculated from the values obtained from albumen height and egg weight by following equation):

$$\text{Haugh Unit} = 100 \log (H + 7.57 - 1.7 W^{0.37})$$

As: H = albumin height (mm)

W = egg weight (gr)

Haugh index : AA 72 gm or more.

A 71-60 .

B 59-31.

C 30 or less (1)

2.5 Egg Quality Characteristics

On individual basis, eggs were evaluated for external and internal egg quality traits. External and internal quality of eggs for all treatments measured at peak of production (30- 33 weeks). Three

eggs per replicate (nine eggs per each treatment) were selected for egg quality specification. The eggs were selected randomly.

2.6 External Egg Characteristics

The external egg characteristics were egg weight (gm), egg dimensions length and width (cm), and shell weight (gr) and shell thickness (mm). The egg dimensions and shell thickness were measured using digital calipers (Gans Gehartet varnie Digital vernier):

2.6.1 Egg shape index: Length and width of egg measured by digital Varnier and egg shape index was calculated as the following equation

$$\text{Egg shape index (\%)} = \frac{\text{Egg width (cm)}}{\text{Egg length (cm)}} \times 100 \quad (2)$$

2.6.2 Egg Shell Thickness (mm): Shell thickness was measured from three different points of the egg (equator, sharp end and broad end) using a digital varnier. The shell thikness measured with egg shell membranes after dryinf for 24 hours at room temperature. Two measurements were made from the broad end, and the sharp end of each egg and the average of each of the two measurements calculated.

2.7 Internal Egg Characteristics:

The internal egg parameters included albumen height (mm), yolk height (cm), albumen weight (g), yolk weight (g), yolk diameter (cm), yolk index%, albumen index%, and Hough unit, yolk and albumen % were measured

2.7.1 Yolk Diameter (mm): Yolk diameter measured by digital Varnier in two edges. The the egg yolk index measured, according to following equation:

$$\text{yolk index} = \frac{\text{Yolk height (mm)}}{\text{Yolk diameter (mm)}} \times 100 \quad (3)$$

2.7.2 Albumen and Yolk Height (mm): The egg was broken on clean flat glass, the height of yolk measured by Tripod micrometer on the center point of the yolk and albumen height was measured in two points (thick and thin) by Ames micrometer to calculate the average of them.

2.8 Fatty Acids and Amino Acids content of Egg:

The determination of fatty acids and amino acids profiles in the egg, 1 egg per replicate and 3 eggs per treatment were selected randomly for theses analysis. The selected eggs were dried in oven (80°C for 48 hours). All dried samples were kept in deep freezer at -18 °C till were analyzed. Amino acids and fatty acids profiles were analyzed according to AOAC (2012) method. Amino acids profile analyzed by Biochrom30 analyzer while fatty acids analyzed by Gas chromatograph (GC

mass) with FID detector and at regional center for food and feed, Agricultural Research center, Ministry of Agriculture, Egypt.

2.9 Sensory Evaluation of Egg

2.9.1 Sample Preparation: Three eggs from each treatment were added to 950ml stainless steel pot, which contained 900 ml tap water and covered with a lid. The gas range was turned on and kept on the highest level until eggs were brought to a low-rolling boil at 8.5 minutes. The heat was turned off and the eggs were kept on the water (lid on) for 20 minutes. The water was drained from pot and eggs were cooled with running tap water until the eggs were considered to be at room temperature. The eggs were peeled and then cut into quarters for delivery to sample plates one-quarter egg from each treatment was delivered to a 15 cm, white paper board plate identified with a 3-digit blind code. (6)

2.9.2 Sensory Evaluation: The sensory attributes tested were

- a- Aroma: Oder of the whole egg
- b- Flavor: the distinctive aroma and taste of yolk
- c- Off-flavor: unusual smell or taste of the yolk
- d- Overall acceptance

The integrated sensation based on aroma, flavor, taste and presence of the off-flavor. For each of the sensory parameters tested, panelists were asked to rate difference between each sample and control using an intensity scale from 1 to 5, where: 1 is the worst and 5 is very good.

2.10 Economic Efficiency Evaluation of Organic and Commercial Egg Production:

2.10.1 Rearing period: hens from 1 day to 18 weeks with all expenses (chicks, feed ,vaccine, electric, labor, and fuel) cost 12,000 ID per 1 chicken.

720 chicken = $720 \times 12000 = 8,640,000$ ID

2.10.2 Production period:

- 1- Organic feed egg production 1 ton price + transport was 800,000 ID
- 2- Commercial feed egg production 1 ton price + transport was 500,000 ID
- 3- Other expenses vaccine, electric, labor, and fuel 1,000,00 per month
- All above expenses are called input.

2.10.3 Egg price in market:

- 1 organic egg = 300 ID
- 1 commercial egg = 150 ID
- 1 local hen 36 weeks age at marketing = 6,000 ID
- 1 commercial hen 36 weeks age at marketing = 5,000 ID
- All above points are output

$$\text{Profit} = R - C$$

R: Output C: input

Output: total incomes from selling eggs and chicken

Inputs: total expense at the beginning of project

2.11 Analysis Statistical:

Data were analyzed using the programme of Statistical Analysis System (25), and the experiment was designed as factorial-CRD. The following module was used to analyze the data:

$$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + \epsilon_{ijk}$$

Where:

Y_{ijk} is the value of kth observation having ith strain and jth treatment,

μ over all mean,

A_i Effect of ith strain (i= com and loc),

B_j Effect of jth treatment (j= T1, T2, T3, T4, T5 and T6),

$(AB)_{ijk}$ Effect of the interaction between ith strain and jth treatment and,

ϵ_{ijk} is the experimental error.

The effect of sex (male or female) was added to the module of carcass traits.

To diagnosing the significant differences between treatments, the proceeding of Duncan's multiple range tests at level of $p \leq 0.01$ was detected.

3. Results and Discussion

Table (2) shows the Haugh unit of commercial eggs under different production systems. the overall mean was 73.08 and significant differences were found among treatments. the highest Haugh unit was in T6 75.65 and significantly differ compare to lowest value of Haugh unit in T2 67.42.

Table.2. Haugh unit of commercial egg under different production systems

Factors	Haugh unit
Overall mean	73.08 ± 1.12a
Treatments	**
T1	73.69 ± 3.05 abc
T2	67.42 ± 2.71 bcd
T3	74.43 ± 1.12 ab
T4	74.14 ± 2.33 ab
T5	73.16 ± 3.88 abc
T6	75.65 ± 2.35 a

¹Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). ² T1: (control) feeding Commercial the full requirement (100% indoor), T2: feeding the full requirement organic (100% indoor), T3: feeding 75% of the full requirement commercial + pasture, T4: feeding 75% of the full requirement organic + pasture, T5: feeding of the full requirement commercial + pasture, T6: feeding of the full requirement organic + pasture. W: weeks.

3.1 Egg Properties

Table (3) showed means of egg properties, effect strains and treatments on egg properties and their interaction. A significant length egg was recorded between strains. (15) compared four breeds of chicken namely Koekoek (KK), Dominant red barred (DRB), Novo color (NC) and Lohmann Brown (LB). This result suggested that egg length did not differ significantly among treatments.

There was a significant difference for shell thickness between strains which were 0.38 mic.ms for fast-growing and 0.35 mic.ms for slow-growing. It is agreed with (16). On the other hand, (21) reported no significant effect of breed on eggshell thickness. The overall mean of shell thickness was 0.36 mic.ms. The same results found by (17). Interaction between strains and treatments were

significantly differences ($P < 0.01$) for slow-growing strain. However, the interaction between fast-growing strain and all treatments did not differ significantly.

Albumin height upper mean was 5.02 and fast-growing strain 5.75mm was significant differ compared to slow-growing strain 4.28mm. According to (15), among treatments there were significant differences ($P < 0.01$) this is same result according to (18); (19) and interaction between strains and treatments were also significant. It is in agreement with (15)

The overall mean of albumin lower upper was 1.01mm. There are significant differences between strains 1.17 mm and 0.84 mm fast-growing, slow-growing respectively. According to (15), T6 found to be differ significantly ($P < 0.01$) compared to all other treatment. this is same result according to (8); (15). The interaction for both strains with treatments was significantly difference. It is in agreement with (15).

3.2 Amino Acid Profile of Eggs from Commercial Strain

The percentage of amino acids (essential and non-essential) in the commercial egg is presented in Table (4). Significant differences found among treatments for amino acid content. This results according to (18) who compared two production systems, organic (aviary) and conventional cage systems and their effects on ISA -Brown egg quality. , they showed eggs produced under organic system had lower ($P < 0.05$) amino acids including Proline (1.17 vs. 1.28 %), Hydroxylysine (0.010 vs. 0.005%) and Ornithine (0.001 vs. 0.005 %). Furthermore, Methionine was marginally higher in organic eggs compared to conventional (1.064 vs. 1.059).

In present study, T6 had higher content of methionine and differ significantly from other treatments. Cysteine percentage in the egg did not differ significantly among organic and commercial treatments. Lysine percentage in T6 was significantly higher compared to the other treatment groups. No significant differences were found among treatments for cysteine, histidine, glycine, and arginine contents in egg under different production systems. Aspartic, Threonine, Valine, Leucine, Serine and Phenylalanine percentage in the egg were significantly difference among treatments. The percentage of glycine and proline in T6 had higher ($P < 0.01$) value compared to the other treatments.

Table 3 The effect of layer strains commercial, local, treatments, interactions on egg properties

Factors		Y. diameter mm	Egg shape index	Shell thickness mic.ms	A.height/ upper mm	A.height/ lower mm
Over all mean		38.19	79.49	0.36	5.02	1.01
Strain		NS	NS	**	**	**
COM		38.20 ± 0.38 a	79.92 ± 0.31 a	0.38 ± 0.01 a	5.75 ± 0.14 a	1.17 ± 0.07 a
LOC		38.19 ± 0.32 b	79.07 ± 0.57 a	0.35 ± 0.01 b	4.28 ± 0.10 b	0.84 ± 0.04 b
Treatments		NS	NS	*	NS	**
T1		37.07 ± 0.68 b	78.67 ± 0.51 a	0.35 ± 0.01 b	5.37 ± 0.28 ba	0.85 ± 0.07 b
T2		37.50 ± 0.78 b	79.95 ± 0.62 a	0.38 ± 0.01 a	4.60 ± 0.21 b	0.99 ± 0.14 b
T3		39.05 ± 0.57 a	79.14 ± 0.95 a	0.36 ± 0.01 b	5.02 ± 0.31 ab	0.92 ± 0.12 b
T4		38.66 ± 0.32 ab	80.49 ± 1.03 a	0.36 ± 0.01 b	5.11 ± 0.28 ab	0.93 ± 0.09 b
T5		38.41 ± 0.43 ab	80.22 ± 0.68 a	0.37 ± 0.01 b	5.00 ± 0.34 ab	1.05 ± 0.05 b
T6		38.74 ± 0.64 ab	78.48 ± 0.86 a	0.37 ± 0.01 b	4.99 ± 0.38 ab	1.31 ± 0.14 a
Interaction		**	NS	NS	NS	*
Strain						
Treats						
COM		35.14 ± 0.44 d	0.36 ± 0.01 bc	79.33 ± 0.59 a	5.81 ± 0.41 ab	0.90 ± 0.13 bc
COM		36.80 ± 1.02 cd	0.41 ± 0.01 a	79.42 ± 0.43 a	5.03 ± 0.32 bcd	1.13 ± 0.19 bc
COM		40.15 ± 0.42 a	0.37 ± 0.01 b	80.00 ± 0.99 a	5.93 ± 0.17 ab	0.96 ± 0.22 bc
COM		39.22 ± 0.52 abc	0.37 ± 0.01 b	80.36 ± 0.78 a	5.91 ± 0.28 ab	1.13 ± 0.13 bc
COM		38.32 ± 0.65 abc	0.37 ± 0.01 b	80.66 ± 0.73 a	5.78 ± 0.47 abc	1.16 ± 0.08 b
COM		39.55 ± 0.52 ab	0.37 ± 0.01 b	79.73 ± 1.02 a	6.06 ± 0.31 a	1.76 ± 0.06 a
LOC		39.00 ± 0.60 abc	0.34 ± 0.01 c	78.01 ± 0.78 a	4.93 ± 0.31 cd	0.80 ± 0.06 bc
LOC		38.20 ± 1.19 abc	0.36 ± 0.01 bc	80.47 ± 1.19 a	4.18 ± 0.13 de	0.85 ± 0.20 bc
LOC		37.94 ± 0.86 abc	0.34 ± 0.01 c	78.28 ± 1.63 a	4.11 ± 0.25 de	0.88 ± 0.13 bc
LOC		38.10 ± 0.24 abc	0.35 ± 0.01 bc	80.62 ± 2.02 a	4.31 ± 0.09 de	0.73 ± 0.07 c
LOC		38.51 ± 0.62 abc	0.36 ± 0.01 bc	79.79 ± 1.18 a	4.23 ± 0.20 de	0.94 ± 0.02 bc
LOC		37.38 ± 1.03 bc	-	77.24 ± 1.25 a	3.91 ± 0.25 e	0.86 ± 0.03 bc

1Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). 2 T1: (control) feeding Commercial ad the full requirement (100% indoor); ad the full requirement organic (100% indoor), T3:feeding 75% of the full requirement commercial + pasture, T4: feeding 75% of the full requirement organic + pasture, T5:feeding requirement commercial + pasture, T6:feeding of the full requirement organic + pasture.). W: weeks, COM:commercial hen, LOC:local hen

Table .4. Amino acids profile of commercial strain egg (percentages content in total protein) for different production system

Amino acids %	Treatments						MSE
	T1	T2	T3	T4	T5	T6	
Aspartic (ASP)	3.39c	1.06d	4.51a	3.97b	3.50c	4.03b	0.27
Cysteine (CYS)	1.17a	1.14a	1.22a	1.02a	1.32a	1.23a	0.03
Methionine	1.60ab	1.53b	1.57ab	1.47b	1.25c	1.73a	0.04
Threonine (THR)	2.07b	2.17ab	2.25ab	2.16ab	1.80c	2.32a	0.04
Lysine (LYS)	2.74bc	2.86b	3.08a	2.82b	2.59c	3.18a	0.05
Valine (VAL)	2.64bc	2.76ab	2.9a	2.72ab	2.42d	2.49cd	0.04
Histadine (HIS)	1.07a	1.09a	1.19a	1.06a	0.95a	1.16a	0.03
Leucine (LEU)	3.33bc	3.37bc	3.78a	3.46b	3.21c	3.88a	0.06
Tyrosine (TYR)	1.79b	2.19a	2.2a	2.13a	1.70b	1.74b	0.06
Isoleucine (ILE)	2.13c	2.19bc	2.39a	2.18bc	2.34ab	2.34ab	0.03
Serine (SER)	2.83c	2.97bc	3.21a	3.03ab	2.41d	3.20a	0.07
Glutamic (GLU)	5.1d	5.3c	6.04a	5.21cd	4.41e	5.85b	0.13
Glycine (Gly)	1.25a	1.45a	1.51a	1.47a	1.4a	1.47a	0.03
Alanine (ALA)	2.34d	2.37d	2.66c	3.14a	2.85b	2.52cd	0.07
Arginine (ARG)	2.65a	2.68a	2.79a	2.66a	2.45b	2.82a	0.04
Proline (PRO)	1.17c	1.12c	1.62b	1.57b	1.29c	1.86a	0.07
Phenylalanine (PHE)	2.08b	2.08b	2.29a	2.05b	1.76c	2.38a	0.05

¹Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). 2 T1: (control) feeding Commercial the full requirement (100% indoor), T2:feeding the full requirement organic (100% indoor), T3:feeding 75% of the full requirement commercial + pasture ,T4: feeding 75% of the full requirement organic + pasture , T5:feeding of the full requirement commercial + pasture, T6:feeding of the full requirement organic + pasture.). 2SEM, standard error of the means (pooled).

3.3 Fatty Acids Profile of Eggs for Commercial Hen Under Different Production System

In table (5) fatty acids profile of eggs from commercial hen is presented. Significant differences were found among treatments. This result was in agreement with (18) ; (20); (19). They used two commercial hybrids White Lohmann (LSL) and Brown (ATAK-S) laying hens, reared under organic and conventional feed from the period 23 to 70 weeks of age. the results of their studies showed that fatty acid profile of egg yolk were significant differences between the organic and conventional rearing system with respect to linolenic acid, total omega-3 fatty acid content, and the omega 6 ,omega 3 ratio, Palmitic acid. The egg in commercial group treatments had higher ($P<0.01$) fatty acids compared to organic treatments T3 had higher ($P<0.0$) content of Oleic acid 52.30 and lowest value was in T6. Significant differences were found among treatments for linoleic acid content in the egg and eggs from T2 had highest value 20.76%. No significant differences were found among treatments of Myristic acid, Gadolic acid, Arachidonic acid, and Docosaheptaenic acid in the eggs under two different production systems. Total MUFA (mono unsaturated fatty acid) in the organic treatments were lower compared to commercial treatments and T1 is 54.09, T6 is 36.96. Organic treatments in total content of UFA (unsaturated fatty acids) and n-6 were higher than commercial group treatments.

Table.5.Fatty acid profile of eggs for commercial hen under different production system

Fatty acids %	Treatments						
	T1	T2	T3	T4	T5	T6	MSE
C14:0 Myristic acid	0.25a	0.25a	0.22a	0.25a	0.48a	0.31a	0.03
C16:0 Palmitic acid	22.12c	20.76e	21.36d	20.93e	28.95a	23.04 _b	0.69
C16:1w7 Palmitioleic acid	2.53a	2.18b	2.08b	1.62c	1.55c	0.53d	0.16
C17:0 Heptadecanoic acid	0.25a	0.30a	0.20a	0.24a	0.21a	0.24a	0.02
C16:3w4 Hexagonic acid	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00
C18:0 Stearic acid	6.68d	6.30e	7.38c	6.16e	8.00a	7.60b	0.17
C18:1 w9 Oleic acid	51.40b	46.57d	52.30a	49.39c	44.16 _e	36.12f	1.33
C18:2 w6 Linoleic acid	14.60c	20.76a	14.26d	18.13b	14.70 _c	14.70c	0.59
C18:3w3 Linolenic acid	0.42d	0.80b	0.59cd	0.90b	0.74b _c	1.11a	0.06
C20:1w9 Gadolic acid	0.16a	0.16a	0.19a	0.18a	0.16a	0.14a	0.02
C20:4w6Arachidonic acid	0.68a	0.72a	0.48a	0.53a	0.53a	0.62a	0.03
C22:6w3 Docosahexaenic acid (DHA)	0.23a	0.23a	0.20a	0.25a	0.16a	0.00a	0.03
C20:2w6 eicosadienoic acid	0.00b	0.00b	0.16a	0.17a	0.15a	0.00b	0.02
C22:3w3 docosapetaenoic acid	0.00c	0.00c	0.54a	0.65a	0.33b	0.33b	0.06
C18:1w7 Vaccenic acid	0.00b	0.00b	0.07ab	0.15a	0.15a	0.17a	0.02
Σ MUFA	54.09	48.91	54.64	51.34	46.02	36.96	
Σ PUFA	15.93	22.51	15.69	19.98	16.28	16.43	
Σ UFA	70.02	71.42	70.33	71.32	62.30	53.39	
Σ n-3	0.65	1.03	1.33	1.80	1.23	1.44	
Σ n-6	15.28	21.48	14.9	18.83	15.38	15.32	

¹Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). 2 T1: (control) feeding Commercial the full requirement (100% indoor), T2: feeding the full requirement organic (100% indoor), T3: feeding 75% of the full requirement commercial + pasture, T4: feeding 75% of the full requirement organic + pasture, T5: feeding of the full requirement commercial + pasture, T6: feeding of the full requirement organic + pasture. 2SEM, standard error of the means (pooled).

3.4 Sensory Evaluation of Commercial Chicken Eggs Under Different Production Systems

Table (6) presented the sensory evaluation of commercial chicken boiled eggs. There were significant differences among treatments for Aroma, Flavor Off-Flavor, and overall acceptances. The lowest score recorded in control treatment aroma 2.90, flavor 2.70, off-flavor 2.80 and overall acceptance 2.80. Among treated eggs from T6 which is fully organic had highest value of each parameters including overall acceptance 4.00, off-flavor 4.10, flavor 4.00 and aroma 3.90. , (21) conducted a study on impact of pasture intake on sensory quality of eggs,. Hens kept under three different systems, hens accessed to clover based pasture with common layer feed and indoor hens fed on layer feed they found distinctive differences between these two systems in sensory of eggs due to type of consumed nutrient intake. Chickens in pasture consume more different types of nutrient such us worms, insects, grass, and pasture.

Table (6). Sensory tests of boiled eggs from commercial strain

Parameters	Aroma	Flavor	Off-Flavor	over all acceptance
¹ T1	2.90 ^b	2.70 ^b	2.80 ^a	2.80 ^b
T2	3.40 ^{ab}	3.90 ^{ab}	3.50 ^a	3.60 ^{ab}
T3	3.30 ^a	3.40 ^{ab}	3.10 ^a	3.20 ^a
T4	3.50 ^{ab}	3.80 ^{ab}	3.60 ^a	3.60 ^{ab}
T5	3.20 ^{ab}	3.50 ^a	3.40 ^a	3.30 ^{ab}
T6	3.90 ^{ab}	4.00 ^{ab}	4.10 ^a	4.00 ^{ab}
² SEM	0.13	0.15	0.12	0.12

¹Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). 2 T1: (control) feeding Commercial the full requirement (100% indoor), T2: feeding the full requirement organic (100% indoor), T3: feeding 75% of the full requirement commercial + pasture, T4: feeding 75% of the full requirement organic + pasture, T5: feeding of the full requirement commercial + pasture, T6: feeding of the full requirement organic + pasture.). 2SEM, standard error of the means (pooled).

3.5 Economic Efficiency Evaluation of Commercial Egg Production:

Table (7) represent economic efficiency evaluation of commercial egg production. The egg profitability was calculated from 18 to 36 weeks, and eggs with hens from 1 to 36 weeks of age. The significant difference found among treatments of commercial strains profit for both eggs and hen with eggs income. The overall profit mean of commercial egg only was 248,180 and eggs with hen was 322,985. The highest profit was in T6 350,804 ID for only eggs, and the highest income for eggs and hens was in T4 436,724 ID.

(22) reported that cost of pasture and labour in organic is about 18.84% of the total production due to need more land for pasture and labour need for collection eggs. In Europe countries cost of organic egg production 45% higher than conventional eggs. In addition, organic layer feed has to be fully organically and its limitation in market lead to increasing cost of production. However, in the market price of organic eggs are much higher than conventional eggs (23). Small and medium egg production farm have greater cost and lower profitability. Also, number of people and their experience are main factors to boost production and profit of business. the more number and experienced people, the more care to the farm and then production (24).

Table (7) The effect of layer strains, treatments on economic profit (ID) of egg production

Factors	Only egg ID (18 -36 Weeks)	Egg with hens ID (1– 36 Weeks)
Overall mean	248,180 ± 22016 a	322,985 ± 22016 a
Treatments	**	**
T1	143,790 ± 3157 ef	218,596 ± 3157 de
T2	289,700 ± 3560 b	364,506 ± 3560 b
T3	190,065 ± 14031 cde	264,871 ± 14031 cd
T4	361,918 ± 10255 a	436,724 ± 10255 a
T5	152,800 ± 2133 def	227,606 ± 2133 de
T6	350,804 ± 10486 a	425,610 ± 10486 a

¹Means followed by different letters in the columns and small letters in the raw are significantly different ($p < 0.05$). 2 T1: (control) feeding Commercial the full requirement (100% indoor), T2: feeding the full requirement organic (100% indoor), T3: feeding 75% of the full requirement commercial + pasture, T4: feeding 75% of the full requirement organic + pasture, T5: feeding of the full requirement commercial + pasture, T6: feeding of the full requirement organic + pasture.). W: weeks,

4. Conclusion

Commercial layer can be reared under different production systems and had an effect on egg properties and its content of fatty, amino acids profiles. Results from sensory evaluation of eggs indicated that organic production system affects the test of eggs and profit from organic system could be higher due to consumer's preferences and market price.

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