A new approach in production system of local layer in Iraqi Kurdistan Region

S. Y. T. Al-Sardary* and H. A. Mustafa
College of Agricultural engineering science of Salahaddin, Iraq

* Corresponding Email: sardar.alsardary@su.edu.krd

Abstract. The study was conducted to investigate the effect of organic system on performance of local layer as a first attempt to apply organic system in the area. A total 360 one-day-old local mixed colored hatched at Evan hatchery- Erbil from eggs brought agricultural research Baghdad chicks were reared in 18 pens indoor 2×2 m for the first 18 weeks of bird's age and each box represented a replicate contains of 20 chicks. At beginning of birds assigned to the same condition and fed the weekly requirement according to Isa Brown guide (2018) on two types of feeds as commercial and organic. Birds were randomly divided into six (6) treatment groups and three (3) replicates per treatment. First treatment (T1): as control 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, while 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 all birds had free access to pasture through a hole from indoor to the outdoor except control T1 and T2 birds housed indoor. The outdoor area measured 2×10 m (1 m2/bird) for each box 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 indicate that haugh unit was (67.14). Total UFA and n-3 in T2 of local egg were higher (P<0.01) than other treatments. T3 had higher content of n-6 (21.13). Birds in T6 of local strain had higher (P<0.01) percentage of amino acids among treatments. The significant difference found between treatments of local strains for both eggs and hen with eggs. Significant differences found among treatments for sensory evaluation of local egg. T6 had higher (P<0.01) score of overall acceptances. In this study results showed that local strain able to perform under organic and commercial condition. The egg properties and fatty, amino and sensory evaluation of local eggs under different production system were differed. Profits from eggs and eggs with hens were different depending on the production systems.

1. Introduction:
Nowadays, organic egg and meat are 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 produced in this system was superior to that of eggs produced in the cages (1 and 2).
Consumers claim that organic eggs are savorier, more nutritious and better than conventional eggs, although there is no solid and consistent evidence in the scientific literature (3). Consumers are therefore willing to pay more than traditional eggs for organically raised eggs. Because of the hens' free access to outdoor life and organic feed intake, organic eggs are predicted to have higher egg quality than conventional ones. Based on the growing interest in organic hen eggs, some studies recently have shown the effects of different housing systems on egg quality (4; 5;6).

According to (7) local chickens represent the main source of meat and eggs in more than 80% of the rural and poor households in developing countries. Though, local chicken production is among the farming activities in the rural communities of Iraq and particularly in Kurdistan that provides opportunities for food security and income for many rural families. Despite the importance of this activity, there is no detailed study evaluating the performance and potential of local chicken production in Iraq and particularly in Kurdistan. There are limited numbers of studies that have compared organic or conventional egg quality. There is growing pressure from animal well-being and consumer groups advocating a global ban of battery cage systems. Therefore, this study compared the nutrient content of organic vs. conventional eggs qualities.

The objective of our studies were to investigate the effects of production systems (conventional and organic) on hen performance and evaluation the productive performance of commercial layer strains by applying conventional and organic systems, and 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 a whole.

2.2. Experimental Design:

A total 360 one-day-old local mixed colored hatched at Evan hatchery- Erbil from eggs brought agricultural research Baghdad chicks were reared in 18 pens indoor 2×2 m for the first 18 weeks of bird's age and each box represented a replicate contains of 20 chicks At beginning of birds assigned to the same condition and fed the weekly requirement according to Isa Brown guide (2016) on two types of fees as commercial and organic. Birds were randomly divided into six (6) treatment groups and three (3) replicates per treatment - first treatment (T1): as control 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, while 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 all birds had free access to pasture through a hole from indoor to the outdoor except control T1 and T2 birds housed indoor. The outdoor area measured 2 × 10 m (1 m²/bird) for each box and separated by fence. The outdoor area designed to provide bird a natural behavior and covered with alfalfa (Medicago sativa).

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 2016). Water provided ad libitum. Organic
feed provided from DSA Agrifood Products kırıklalı - 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          |         |
| Salt          | 1.0        |               |         |
| Calculated nutrient content (%) | | | |
| Protein       | 19.56      | Protein       | 19.86   |
| Metabolizable energy (kcal/kg) | 2622.14   | Metabolizable energy (kcal/kg) | 2625.0 |

2.3.1. **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) \hspace{1cm} (8).

Haugh index : AA 72 gm or more.

A 71-60 .

B 59-31.

C 30 or less \hspace{1cm} (9)

2.3.2. **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 according.
2.3.3. *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):

2.3.3.1. Egg shape index:

Length and width of egg measured by digital Vernier and egg shape index was calculated as the following equation

\[
\text{Egg width (cm)} \div \text{Egg length (cm)} \times 100
\]

2.3.3.2. Egg Shell Thickness (mm):

Shell thickness was measured from three different points of the egg (equator, sharp end and broad end) using a digital vernier. The shell thickness measured with egg shell membranes after drying 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.

2.4. *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.

2.4.1 Yolk Diameter (mm):

Yolk diameter measured by digital Vernier in two edges. The the egg yolk index measured, according to following equation:

\[
\text{Yolk height (mm)} \div \text{Yolk diameter (mm)} \times 100
\]

2.4.2. 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.

2.5. *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 these 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 (11) method. Amino acids profile analyzed by Biochrom30 analyzer while fatty acids analyzed by Gas chromatography (GC mass) with FID detector and at regional center for food and feed, Agricultural Research center, Ministry of Agriculture, Egypt.

2.6. Sensory Evaluation of Egg:

2.6.1. Sample Preparation:

Three eggs from each treatment were added to 950 ml 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, while paper board plate identified with a 3-digit blind code. (12)

2.6.2. 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.

2.7. Economic Efficiency Evaluation of Organic and Commercial Egg Production:

A - 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 × 12000 = 8,640,000 ID

B - 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.

C- Egg Price in Market:

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

**Profit = R - C**

| R: Output | C: input |
|-----------|----------|
| Output: total incomes from selling eggs and chicken |
| Inputs: total expense at the beginning of project |

2.8. Analysis Statistical:

Data were analyzed using the programm of Statistical Analysis System (13), and the experiment was designed as factorial-CRD. The following module was used to analyze the data:

\[ Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + \sigma_{ijk} \]

Where:

- \( Y_{ijk} \) is the value of \( k \)th observation having \( i \)th strain and \( j \)th treatment,
- \( \mu \) over all mean,
- \( A_i \) Effect of \( i \)th strain (\( i = \text{com and loc} \)),
- \( B_j \) Effect of \( j \)th treatment (\( j = \text{T1, T2, T3, T4, T5 and T6} \)),
- \( (AB)_{ij} \) Effect of the interaction between \( i \)th strain and \( j \)th treatment and,
- \( \sigma_{ijk} \) is the experimental error.

3. Results and Discussion:

3.1. Haugh Unit

Table 2 shows the Haugh unit of local eggs that produced under two different production systems. Significant differences were found among treatments and the overall means was 67.14. The highest value was in T1 72.09 and the lowest value was recorded in T6.

3.2 Egg Properties:

Table (3) showed means of egg properties, effect strains and treatments on egg properties and their interaction. A significant length egg was was recorded between strains. (14) compared four breeds of chicken namely Koekoek (KK), Dominant red barred (DRB), Novo color(NC) and Lohmann Brown (LB) . Their results suggested 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 (15). On the other hand,(1) reported no significant effect of breed on eggshell thickness. The overall mean of shell thickness was 0.36 mic.ms. \(^\text{\textbackslash}The same results found by (16). 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.
Table 2. Haugh unit of local eggs under different production systems

| Factors     | Haugh unit            |
|-------------|-----------------------|
| Overall mean| 67.14 ± 0.97 b        |
| Treatments  | **                    |
| T1          | 72.09 ± 2.49 abc      |
| T2          | 65.80 ± 2.05 cd       |
| T3          | 66.31 ± 2.24 bcd      |
| T4          | 68.73 ± 0.96 abcd     |
| T5          | 67.10 ± 2.17 bcd      |
| T6          | 62.80 ± 2.99 d        |

1 Means 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.

Albumin height upper mean was 5.02 and fast-growing strain 5.75mm was significant different compared to slow-growing strain 4.28 mm according to (14), among treatments there were significant differences (P<0.01) this is same result according to (17); (18) and interaction between strains and treatments were also significant. It is in agreement with (14)

The overall mean of albumin lower upper was 1.01 mm. There are significant differences between strains 1.17 mm and 0.84 mm fast-growing, slow-growing respectively. According to (14), T6 found to be differ significantly (P<0.01) compared to all other treatments. this is same result according to (17); (18). The interaction for both strains with treatments was significantly different. It is in agreement with (14).
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 ab | 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 ± a0.32 b | 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 | 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 | T1 | 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 | T2 | 40.15 ± 0.42 a | 0.37 ± 0.01 b | 80.00 ± 0.99 a | 5.93 ± 0.17 ab | 1.06 ± 0.22 bc |
| COM | T3 | 39.22 ± a0.52 abc | 0.37 ± 0.01 b | 80.36 ± 0.78 a | 5.91 ± 0.28 ab | 1.13 ± 0.13 bc |
| COM | T4 | 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 | T5 | 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 |
| COM | T6 | 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 | T1 | 38.20 ± 1.19 abc | 0.36 ± 0.01 b | 80.47 ± 1.19 a | 4.18 ± 0.13 de | 0.85 ± 0.20 bc |
| LOC | T2 | 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 | T3 | 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 | T4 | 35.51 ± 0.62 abc | 0.36 ± 0.01 bc | 79.79 ± 1.18 a | 4.23 ± 0.20 de | 0.94 ± 0.02 bc |
| LOC | T5 | 37.38 ± 1.03 bc | - | 77.24 ± 1.25 a | 3.91 ± 0.25 e | 0.86 ± 0.03 bc |
| LOC | T6 | 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), T2:feeding 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 of the full requirement commercial + pasture, T6:feeding of the full requirement organic + pasture.). W: weeks, COM:commercial hen, LOC: local hen.
3.3 Amino Acids Profile of Eggs from Local Strain:

Table (4) shows the percentage of amino acid content of egg from local hen under two types of production system commercial and organic. Significant differences among treatments were detected for amino acids profile of egg. This result was in agreement with (17). The highest methionine percentage was recorded in T2. No significant differences of threonine were found among treatments. There are significant differences of lysine and valine percentage under both types of production systems (commercial and organic). However, T2 had higher (P<0.0) percentage of these two amino acids. Among treatments no significant differences were found of Histadine, Glycinc, and Argnine percentage in the eggs. Phenylalanine content in egg in organic treatments were higher(p<0.01) compared to commercial treatments. Significant differences were found among treatments for Aspartic, Cysteine, Leucine, Isoleucine, Glutamic, and Tyrosine percentage in the egg. These results were in agreement with those of to (17) who showed that eggs produced under organic system had significantly lower amino acids 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 %).

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

| Amino acids % | T1       | T2       | T3       | T4       | T5       | T6       | MSE  |
|---------------|----------|----------|----------|----------|----------|----------|------|
| Aspartic (ASP)| 4.12c    | 4.31b    | 4.49ab   | 4.39b    | 4.40b    | 4.66a    | 0.04 |
| Cysteine (CYS)| 1.14c    | 1.45b    | 1.10c    | 1.12c    | 1.11c    | 1.67a    | 0.06 |
| Methionine    | 1.66b    | 1.93a    | 1.60b    | 1.56b    | 1.62b    | 1.73b    | 0.04 |
| Threonine (THR)| 2.15a | 2.34a    | 2.28a    | 2.26a    | 2.28a    | 2.30a    | 0.02 |
| Lysine (LYS)  | 2.96b    | 3.17a    | 3.18a    | 3.04ab   | 2.96b    | 3.23a    | 0.03 |
| Valine (VAL)  | 2.73c    | 3.06a    | 2.95ab   | 2.8bc    | 2.96ab   | 3.09a    | 0.04 |
| Histadine (HIS)| 1.07a  | 1.17a    | 1.19a    | 1.15a    | 1.16a    | 1.23a    | 0.02 |
| Leucine (LEU) | 3.39c    | 3.63b    | 2.42d    | 3.66b    | 3.64b    | 3.99a    | 0.12 |
| Tyrosine (TYR)| 2.27a    | 2.02b    | 2.31a    | 1.81c    | 2.07b    | 2.2ab    | 0.05 |
| Isoleucine (ILE)| 2.19d | 2.38bc   | 2.42bc   | 2.3cd    | 3.64a    | 2.52b    | 0.12 |
| Serine (SER)  | 3.03b    | 3.13b    | 3.38a    | 3.20b    | 3.14b    | 3.07b    | 0.03 |
| Glutamic (GLU)| 5.45d    | 5.56d    | 6.07ab   | 5.74c    | 5.93b    | 6.22a    | 0.07 |
| Glycinc (Gly) | 1.33a    | 1.42a    | 1.51a    | 1.56a    | 1.38a    | 1.57a    | 0.03 |
| Alanine (ALA) | 2.42d    | 2.61c    | 2.62c    | 3.28a    | 2.49cd   | 2.84b    | 0.07 |
| Argnine (ARG)| 2.72a    | 2.82a    | 2.88a    | 2.79a    | 2.89a    | 2.95a    | 0.03 |
| Proline (PRO) | 1.21c    | 1.49b    | 1.83a    | 1.59b    | 1.63b    | 1.57b    | 0.05 |
| Phenylalanine (PHE) | 2.20b | 2.34ab   | 2.40a    | 2.35ab   | 2.45a    | 2.51a    | 0.03 |

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 Acid Profile of Eggs for Local Hen Under Different Production System:

In table (5) fatty acids profile of eggs from local hen is presented. There were significant differences among treatments. This result was in agreement with those of (17); (18). 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. There were significant differences between the organic and conventional rearing system with respect to linolenic acid, total omega-3 fatty acid content. The omega 6/omega 3 ratio Palmitic acid content in eggs was significantly differ among commercial and organic treatments. T6 had lowest (P<0.0) content of Oleic acid 42.67 and highest value was in T1. Organic treatments T2, T4, and T6 contained high amount of Linolenic acid No significant difference found among treatments For Docosahexaenic acid (DHA) content in eggs. Also, no significant differences found among treatments for Myristic acid, Heptadecanoic acid, Hexagonic acid, Gadolic acid, and Arachidonic acid content in the eggs under different production systems.
| Fatty acids                  | T1    | T2    | T3    | T4    | T5    | T6    | MSE  |
|-----------------------------|-------|-------|-------|-------|-------|-------|------|
| C14:0 Myristic acid        | 0.34a | 0.20a | 0.30a | 0.26a | 0.30a | 0.37a | 0.02 |
| C16:0 Palmitic acid        | 22.30e| 21.95f| 24.37a| 23.40c| 22.62d| 23.70b| 0.20 |
| C16:1w7 Palmitioleic acid  | 3.38a | 2.39d | 2.67c | 2.56cd| 3.02b | 2.48d | 0.09 |
| C17:0 Heptadecanoic acid   | 0.24a | 0.27a | 0.24a | 0.23a | 0.24a | 0.3a  | 0.02 |
| C16:3w4 Hexagonic acid     | 0.16a | 0.00a | 0.14a | 0.15a | 0.15a | 0.14a | 0.08 |
| C18:0 Stearic acid         | 6.88d | 7.38b | 7.66a | 6.95cd| 7.67a | 7.10c | 0.45 |
| C18:1 w9 Oleic acid        | 47.92a| 44.20c| 46.50b| 43.80d| 46.53b| 42.67e| 0.51 |
| C18:2 w6 Linoleic acid     | 15.71c| 20.12a| 15.40d| 19.20b| 15.85c| 20.00a| 0.05 |
| C18:3w3 Linolenic acid     | 0.53c | 0.81b | 0.95ab| 1.03a | 0.61c | 0.93ab| 0.02 |
| C20:1w9 Gadolic acid       | 0.19a | 0.19a | 0.21a | 0.21a | 0.22a | 0.21a | 0.03 |
| C20:4w6 Arachidonic acid   | 0.92a | 1.01a | 0.85  | 0.90  | 0.90a | 1.10a | 1.00 |
| C22:6w3 Docosahexaenic acid (DHA) | 0.35a | 0.40a | 0.38a | 0.46a | 0.41a | 0.37a | 0.02 |
| C20:2w6 eicosadienoic acid | 0.00a | 0.00a | 0.00a | 0.00a | 0.00a | 0.00a | 0.00 |
| C22:3w3 docosapetaenoic acid | 0.88ab | 0.88ab | 0.69bc | 0.77ab | 0.92a | 0.53c | 0.04 |
| C18:1w7 Vaccenic acid      | 0.06a | 0.16a | 0.06a | 0.18a | 0.15a | 0.20a | 0.02 |
| ∑ MUFA                     | 51.55 | 46.94 | 49.44 | 46.75 | 49.92 | 45.56 |
| ∑ PUFA                     | 17.51 | 22.34 | 17.58 | 21.59 | 17.97 | 22.30 |
| ∑ UFA                      | 69.06 | 69.28 | 67.02 | 68.34 | 67.89 | 67.86 |
| ∑ n-3                      | 1.92  | 2.09  | 2.02  | 2.26  | 1.68  | 1.97  |
| ∑ n-6                      | 16.63 | 21.13 | 16.25 | 20.10 | 16.95 | 21.00 |

1Mean values 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 Sensory Evaluation of Local Chicken Eggs under Different Production Systems:

A table (6) shows the sensory evaluation of boiled eggs from local chicken significant differences was found among treatments for all parameters. T5 and T6 had similar overall acceptances. T1 which fed on commercial feed only, had lowest scores overall acceptance 2.70 and its’ aroma score was 2.60. The best score for aroma and flavor was 4.00 in T6. In the literature, effect of hen types that reared under organic system on quality and sensory of eggs has not been well documented. (5) conducted a study used hybrid hens (Hy-Line White and Hy-Line Brown) and dual-purpose hens (Sussex plus Rhode Island) under organic production. Their results of a sensory evaluation of boiled eggs at 43 weeks of hen age reveals that Another factor that related to the sensory of eggs is related to pasture intake, (19) 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 as worms, insects, grass, and pasture.

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

| Treatments | aroma | Flavor | Off-Flavor | over all acceptance |
|------------|-------|--------|------------|---------------------|
| T1         | 2.60  | 2.70   | 2.90       | 2.70                |
| T2         | 3.40  | 3.10   | 3.60       | 3.30                |
| T3         | 3.20  | 2.80   | 3.20       | 3.20                |
| T4         | 3.90  | 3.60   | 3.80       | 3.70                |
| T5         | 3.70  | 3.80   | 4.00       | 3.90                |
| T6         | 4.00  | 4.00   | 3.70       | 3.90                |

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).

3.6 Economic Efficiency Evaluation of Local Egg Production:

Table (7) represents economic efficiency evaluation of organic and commercial egg production. The egg profitability was calculated from 18 to 36 weeks, and eggs with hens from 1 to 36 weeks of age. Significant differences were found among treatments for both only egg and hen with eggs profit. The mean of only eggs profit was 146,627 and eggs with hen was 241,432 ID. The profit from eggs only in T4 recorded 207,892 ID which was the heist income compared to other treatments and the most income from hen with eggs was in T4 302,698 ID.
(20) 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 (21). Small and medium egg production farm have greater cost and lower profitability. Also, number of people and their experience are a main factors to boost production and profit of business. the more number and experienced people, the more care to the farm and then production (22).

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 means | 146,627 ± 14516 b | 241,432 ± 14516 b |
| Treatments ** | 290,558 ± 14329 c | 302,698 ± 24815 c |
| T1 | 75,810 ± 12952 g | 209,492 ± 15004 ef |
| T2 | 195,752 ± 14329 cd | 290,558 ± 14329 c |
| T3 | 114,686 ± 15004 fg | 209,492 ± 15004 ef |
| T4 | 207,892 ± 24815 c | 302,698 ± 24815 c |
| T5 | 94,545 ± 14614 g | 189,351 ± 14614 ef |
| T6 | 191,076 ± 29581 cde | 285,882 ± 29581 c |

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
Local hen strains usually reared in the rural areas, it can be reared under different production systems. In this study results showed that local strain able to perform under organic and commercial condition. The egg properties and fatty, amino and sensory evaluation of local eggs under different production system were differed. Profits from eggs and eggs with hens were different depending on the production systems.

References:
[1] Wang, K. H., Shi, S. R., Dou, T. C., and Sun, H. J. 2009. Effect of a free-range raising system on growth performance, carcass yield, and meat quality of slow-growing chicken. Poultry Science, 88(10), 2219-2223.
[2] Anderson, K. E. (2011). Comparison of fatty acid, cholesterol, and vitamin A and E composition in eggs from hens housed in conventional cage and range production facilities. Poultry Science, 90(7), 1600-1608
[3] Kouba, M. (2003). Quality of organic animal products. Livestock Production Science, 80(1-2), 33:40.
[4] Cerolini, S., L. Zaniboni and R. La Cognata. 2005. Lipid characteristics in eggs produced in different housing systems. Ital. J. Anim. Sci. 4:520.
[5] Rizzi, L., Simioli, G., Martelli, G., Paganelli, R., & Sardi, L. 2006. Effects of organic farming on egg quality and welfare of laying hens. In XII Eur Poult Conf (pp. 10-14).
[6] Minelli, G., F. Sirri, E. Folegatti, A. Meluzzi, and A. Franchini. 2007. Egg quality traits of laying hens reared in organic and conventional systems. Ital. J. Anim. Sci. 6:728–
[7] Tan, X. B., Lam, M. K., Uemura, Y., Lim, J. W., Wong, C. Y., Ramli, A., ... & Lee, K. T. (2018). Semi-continuous cultivation of Chlorella vulgaris using chicken compost as nutrients source: Growth optimization study and fatty acid composition analysis. Energy conversion and management, 164, 363:373.

[8] Monira, k.n., Salahuddin, M. and Miah, g. 2003. Effect of breed and holding period on egg quality characteristics of chicken. Inter J of Poult Sci 2: 261-3.

[9] Abdurehman, A. and Urge, M., 2016. Evaluation of fertility, hatchability and egg quality of rural chicken in gorogotu district, Eastern Hararghe, Ethiopia. Asian Journal of Poultry Science, 10(2), pp.111-116.

[10] Ibrahim, K.I. (2000). Poultry feed. Ministry of Higher Education and Scientific Research- University of Mosul. 2nd ed. (Arabic).

[11] AOAC, (2012). Official Methods of Analysis of AOAC INTERNATIONAL. 19th Ed., AOAC 50 INTERNATIONAL, Gaithersburg, MD, USA.

[12] Cherian, G., Holsonbake, T.B. & Goeger, M.P., 2002. Fatty acid composition and egg components of specialty eggs. Poultry Science. 81, 30-33.

[13] SAS. (2002). SAS/STAT® User’s Guide for Personal Computers. Release 8.2. SAS Institute Inc., Cary, NC, USA.

[14] Alemu, L.T.2017. Study on the meat and egg quality of different chicken breeds at debrezeit agricultural research center . MSc Thesis Addis Ababa University. Ethiopia.

[15] Zita, L., Tůmová, E., and Štolc, L. 2009. Effects of genotype, age and their interaction on egg quality in brown-egg laying hens. Acta Veterinaria Brno, 78(1), 85-91.

[16] Arpášová, H., Halaj, M., and Halaj, P. 2010. Eggshell quality and calcium utilization in feed of hens in repeated laying cycles Czech Journal of Animal Science, 55(2), 66-74.

[17] Taha, S, Y., 2012. A comparison of egg quality from hens reared under organic and commercial systems . Agriculture and Forestry Research, Special Issue No 362 (Braunschweig, 2012) ISSN 0376-0723.

[18] Küçükyılmaz, K., Bozkurt, M., Herken, E.N., Çınar, M., Çatlı, A.U., Bintaş, E. and Çöven, F., 2012. Effects of rearing systems on performance, egg characteristics and immune response in two layer hen genotype. Asian-Australasian Journal of Animal Sciences, 25(4), p.559.-568.

[19] Horsted C, Chiericato GM. Organic farming production. 2005 .Effect of age on the productive yield Fatty acid composition of certified organic, conventional and omega-3 eggs. Food Chem. 116, 911-914.

[20] Tserveni-Gousi, A., Yannakopoulos, A., Christaki, E., Florou-Paneri, P., Botsoglou, N. and Yannakakis, E., 2005. Sensory evaluation of eggs enriched with n-3 fatty acids in Greece. Publication –European Association for Animal Production, 115, p.495

[21] Latacz-Lohmann, U., & Renwick, A. 2002. An economic evaluation of the Organic Farming Scheme. In Proceedings of the UK Organic Research 2002 Conference (pp. 311-312). Organic Centre Wales, Institute of Rural Studies, University of Wales Aberystwyth.

[22] Osti, R., Deyi, Z., Virendra, S., Dinesh, B. and Harshika, C., 2016. An economic analysis of poultry egg production in Nepal. Pakistan Journal of Nutrition, 15(8), pp.715-724.