Effects of using processed barley and supplemented multi-enzymes in laying hen rations on egg production, egg quality and egg fatty acids

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Abstract

In this study, we have observed different technological processes which are commonly used in poultry production. Rations contained different amounts of barley and multi- enzyme, egg weight, egg mass, egg yield, feed intake, egg weight. The control groups were 0% barley (based of corn) (K), 15% untreated barley (A1), 15% pellet barley (A2), 15% flaked barley (A3), 30% untreated barley (A4), 30% pelleted barley (A5), 30% flaked barley (A6), 30% untreated barley+ Enzyme (0. 025 %) (A7). In the research, 64 brown laying hens ATAK-S for 36 weeks were divided into 08 different treatments for egg hens. Thirty-week-old laying hens were divided into 08 groups of 08 animals each with a similar live weight. Each treatment consisted of 08 animals in individual cages. Animals were completely randomly determined, grown in individual cages and were kept under a 16:8 hours light: dark lighting period. Feed and water were given as ad- libitum. The highest egg weight was obtained from chickens fed with A2 group (62.98 g) and those chickens fed with A1 group (56.45 g) showed lowest egg weight ($P \leq 0.01$) In terms of total egg mass, the statistical differences between the experimental groups were very important, but A2 had the highest

value and A4 group had the highest value. (P≤ 0.01). When considering the average feed consumption, feed consumption of A2 fed chickens was higher than the other groups (P ≤ 0.001). Feed consumption of chickens fed A4 and A7 groups were significantly less than that of A1 group and K group feed consuming groups (P ≤ 0.001). There was no significant difference in mean egg yield between treatments. When egg weight average was examined, it was found that egg weight was higher than A4 group weight ratios when A7 group added weighted ration was considered (P ≤ 0.01). When we examined the omega- 6 (n- 6) and omega-3 (n- 3) fatty acids in the trial, Linolelaidic acid, one of the omega 6 fatty acids, was found to differ between treatments (P ≤ 0.05). The lowest value for linolelaidic acid ranged from 0.022 to A3 group, while the highest value was 0.046 to A2 group.

Key Words: barley, enzyme, flaking, pellet, egg production, egg quality laying hens, egg yolk fatty acids

1. Introduction

Barley, wheat, sorghum, rye and triticale have been considered as alternative feed raw materials in poultry feed production for years in order to reduce the problems in corn production and prices. Although barley can be used in large and small ruminant feeds in sufficient amounts without any problem, the use of barley is limited in poultry feeds due to the inclusion of more than 10% rate of barley [1]. In addition, the grinding method, heat treatment and particle size are important variables that determine feed production costs, feed consumption and digestibility, and potentially egg quality in laying hens. Heat treatment is widely used to increase apparent ileal digestibility of nutrients, improve feed hygiene and reduce anti-nutritional factors [2- 5]. In order to solve these problems and to use these cereal feeds in poultry nutrition and to use them successfully, researches have been made on various applications. The most common of these applications are technological

processes such as flaking, pelletizing, expander and annealing processes. In addition, exogenous enzymes such as beta-glucanase and cellulase are used to increase the digestibility of cellulose found in the arabinoxylan [3- 7]. As a result, it was concluded that the nutritional preventive factor detected in barley grains is beta-glucans (β-glucans) which cannot be easily digested by poultry due to its chemical structure. Beta-glucans bind with water in the intestine and cause gel formation and increased viscosity of the intestinal contents [4- 8]. The development of enzyme preparations has found a widespread application in the feed industry [5].

It is stated that many processed grains have higher metabolic energy than whole grain. However, processing techniques have been reported to affect the digestion rate, location and distribution of protein, starch and cellulose present in feed [6- 9]. Steam-cooked food is easier to digest for animals because the starch in it is gelatinized. It causes the death of harmful bacteria (Salmonella). Although starch gelatination occurs in feeds with the application of Expander is a chemical effect, it is necessary to mention the physical effect caused by this chemical effect. Starch gelatinized pulp feed can be better pelleted with minimum loss [7]. Flaking; is a product based on the principle of cooking cereals such as barley, wheat and corn under high pressure with steam and then passing through crushing machine. These positive effects have been found to be due to the degradation of water-soluble β- glucans and activation of endogenous enzymes in cereals. Despite the increase in intestinal viscosity by heat treatment of the bush, the growth performance of the chickens improved. It is possible to use it as an alternative to corn and wheat in poultry diets only with the improvement of some technological processes and the addition of exogenous enzymes to the ration. For this purpose, the use of different levels of flake barley and pelleted barley, which have been widely obtained recently, have been investigated in different ratios in egg laying hen rations. In

addition, the effects of technological processes and the effects of enzymes were compared by adding multi- enzyme additive to the egg laying hen rations fed with barley.

2. Materials and methods

In this research, 64 brown laying hens Atak- S were used as a study animal and the experiment was conducted in the research and application farm of the Faculty of Agriculture, Department of Animal Science. Egg laying hens, used in the experiment, were randomly placed in individual cages in 08 groups with 08 hens in each group. After two weeks of control feeding, the hens were fed with treatments including non-barley control group having 0% barley (maize weight) (K), 15% cracked barley (A1), 15% pelleted barley (A2), 15% flaked barley (A3), 30% cracked barley (A4), 30% pelleted barley (A5), 30% flaked barley (A6), 30% cracked barley+ Enzyme (0.025%) (A7).The rations prepared ration started to be fed to 36-week-old hens in 12 June 2015. During the 08 weeks (58 days) of the experiment, the light system was set to be 16 hours of light daily and 8 hours of darkness. The eggs obtained were collected daily and weighed. Feeding was given by weighing each day and the remaining feeds were collected at the weekend and daily feed consumption was determined. The pelleted barley was obtained to be 04 mm from the same pellet feed unit and then granulated. Flaked barley; Grain barley was crushed in a cauldron after steaming for a certain time (3- 5 minutes for wet crushing, 15- 30 minutes for flake). The crushed barley, which has a high moisture content, was made into a thin layer and dried and cracked to a certain size and made ready for consumption. Enzymes in rations; For poultry, β glucanase based (*EuroZyme XP*) enzyme additive enzyme is used in multi- enzyme combination weighted and barley weighted feeds. Endo-

1, 4- ß- Xylanase 336,000 TXU; Endo-1,4- ß- Glucanase 150,000 TGU; Calcium Carbonate 940,000 MG; Phytase Enzyme 350,000 FTU

The research barn is 7.00 x 5.20 x 2.32 m in dimensions, each block has 03 floors and 06 individual cages on each floor and a total of 72 individual cages were available. In addition, the temperature of the test chamber was continuously monitored by a **Digital** Room Thermometer during the experiment. Room temperature was maintained between 23- 25 ºC for 24 hours. Fluorescent lamps were used to illuminate the trial room and 16: 8 hours of light (21: 00- 05: 00) dark (05: 00– 21: 00) lighting program was applied during the trial. Ventilation is provided by a 15 Kw/ h capacity aspirator placed on the wall. The daily egg yields of the chickens were recorded for 02 weeks before the start of the experiment, and at the end of the 2nd week. Feed ingredients and nutrient composition of the experimental diets are given in Table 1.

Table 1. Feed ingredients of experimental diets and their nutrient analysis

The dry matter, crude ash, crude fat, crude protein and crude cellulose analysis of the rations, used in the experiment, were carried out according to *Weende* analysis system in the Department of Animal Science and Feeding Department of the Faculty of Agriculture [8]. Live weight of laying hens at the beginning and end of the experiment was determined and the difference was taken as live weight change. Individual feed consumption was determined daily and evaluated on a weekly basis. All animals in the experiment were given feeders of the same weight. In order to determine feed consumption during the trial, the weighing was performed once a day at 9: 30 in the morning. From the beginning of the trial period to the last day of the experiment, eggs were collected once a day at 16:00. Then, the weight of the yolk separated from the egg whites by breaking the eggs was weighed on a 0.1 g precision scale, yellow height, yellow index white height; white width was

measured with micrometer and recorded on the quality scale. The yellow index is found by dividing the height of yellow by its diameter and multiplying by 100. This measurement has an accuracy of 0.001, after the egg is broken on a flat- smooth surface, the yellow height with the help of a three-legged micrometer and its width and diameter with the help of a caliper (Made by B C Ames Co, Waltham, Massachusetts, USA, 1937- 1990, used by the NSW Egg Corporation).The shell was cleared so that no white remained in the shell. The shell samples taken from the pointed, middle and blunt parts of the eggshell were measured in micrometer screw gauge and recorded on the egg quality scale. Eggs as internal and external quality criteria; width, shell weight, shell thickness (pointed-medium-blunt), white and yellow weight, yellow color scale (Roche *Yellow Color Range*, 1- 15), white and yellow height, white and yellow diameter measured, shape index, yellow index and white index were calculated. For the analysis of fatty acids in egg yolks, a total of 32 samples were taken from each group of the experiment. These eggs were first weighed for 10 minutes and then weighed again. The yellows were removed, weighed individually and mixed by crushing and homogenized. Briefly, the lipid from the egg yolk was extracted with a hexane/ isopropanol mixture (3: 2 v/ v). Total fatty acids of the samples were determined using an HP 5890 gas chromatography with a flame ionization detector (Hewlett Packard 5890 Series II, Palo Alto, CA, USA). FAME was separated using a Supelcowax- 10 fused silica capillary column (100 mx 0.32 mmx 0.25 mm; Supelco, Bellefonte, PA, USA) with a helium flow of 1.2 ml/ min. The oven temperature was increased from 220 to 240 °C at a rate of 2 °C/ min. Injection and fixation temperatures were 240 and 250 °C, respectively. The peak values of the fatty acids were determined by comparing the retention time and peak area of each fatty acid standard, respectively. The data obtained from the experiment were analyzed with variance analysis using *General Linear Model (PROC GLM)* procedure in accordance with the experimental model (Random Parcels Trial Plan) using SAS [9]

package program. Differences between the groups were analyzed according to Duncan's multiple comparison test. At the end of the study, the results obtained are presented in the tables with the means of group averages, mean standard error (SEM) results of the differences between the groups. At the end of the study, the results were presented in the tables with the means of group averages, mean standard error (SEM) results of the differences between the groups.

3. Results and discussion

In this study, the effect of Attack- S chickens fed with barley processed differently with added enzyme on weekly and average feed consumption during the trial period is given in Table 2. In the experiment, the daily feed consumption values of the groups were subjected to multiple comparison tests and the difference between the groups in terms of daily feed consumption was found to be very statistically significant ($P< 0.001$). When the daily feed consumption values of chickens are evaluated comparatively; Group a1 had the highest daily feed consumption with 107.31 grams, while the lowest daily feed consumption was the group with 98.10 grams. Feed consumption varied between 98.10– 107.31 g according to the groups and was found to be very different statistically ($P \leq 0.001$).

Table 2. The effect of using different processed and multi-enzyme on productive parameters of laying hens.

In this period, a decrease in feed consumption occurred with the use of barley instead of corn in the mixed feed and this decrease in feed consumption was eliminated with the addition of enzyme and the feed n another study, laying hens were fed with different ratios of micronized barley and wheat weight rations. When the effect of micronization on average feed consumption was examined at the end of the total trial period, it was observed that chickens fed with non-micronized

barley feed consumed very close feed. Although there is no statistical difference between the groups in terms of feed consumption, daily feed consumption varied between 108- 113 g [10]. When compared with the study conducted in this study, the results obtained were similar, although it was observed that there was a difference between the groups in terms of daily feed consumption. As it is known, gelatinization of starch in heat treatments applied to feed may cause energy synergy in poultry. Accordingly, this difference may be due to the gelatinization rate of starch between micranization and pelletizing application.

The effect on weekly and average egg yields (Table 2) of chickens fed with different processed barley during the total periods is given in Table 2. When the egg yield of the groups was subjected to multiple comparison test, a difference was observed between the groups and this difference is given in Table 2. For example, in the multiple comparison test, a statistical difference was observed between the groups consuming corn (70.13%) and the groups consuming pellet feed (71.64%).There was a statistical difference between the groups in terms of egg weight($P \leq 0.01$) and egg weight data of the groups in the total period are given in Table 2. When egg weight averages were examined, it was found that the highest egg weight was obtained from chickens fed with A2 group (62.98 g) and the lowest egg weight was obtained from chickens fed with A1 group (56.45 g) ($P \leq 0.01$). The study lasted 135 days and when the whole study was considered, there was no significant difference in egg weight between the groups. The average egg production of hens of different processed barley feeds during the total period is given in Table 2. As shown in the table, chickens consuming a roasted barley-based ration (124 °C) had lower egg weight, an extra- large size of eggs, and a higher Haugh unit score, medium- sized, and B and C-grade eggs than the group consuming unroasted barley-based rations. When the average egg mass production is examined, it is seen that the lowest production is obtained from the chickens consuming A4

group weighted feed ($P \leq 0.001$). The highest egg production was observed in chickens consuming A2 group feed and the egg mass production of this group was found to be significantly higher compared to the chickens fed with A4 group and A5 group as well as chickens fed with K group feed ($P \leq 0.001$). In addition, when egg mass production average is examined, it has significantly improved egg production compared to feeding with A7 group and feeding with A4 group ($P \leq 0.001$). In other researches; Yildiz [11] gamma irradiated wheat and barley feed with different doses of feed during the period of 36-46 weeks of the egg and average egg production of the eggs examined only average egg production was statistically significant differences ($P \leq 0.05$) but the difference in the other weeks was not significant. .

Table 3. The Effect of Using Different Processed and Multi-Enzyme Barley on Egg Quality

Heat treatment is widely used to increase apparent ileal digestibility of nutrients, improve feed hygiene and reduce anti-nutritional factors [12; 13]. Leghorn chickens consuming a ration based on roasted barley at 125 °C were found to have higher *Haugh unit* scores than chickens fed on unroasted diets [14]. On the other hand, in a previous study, it was shown that the heat treatment of the feed did not affect egg quality parameters including weight, *Haugh unit* and blood stain, and that other egg quality variables of economic importance were not taken into consideration. The experimental period data of egg quality criteria last weeks are given in Table 3. When the egg shell fracture strength criteria were examined, no significant difference was found at the end of the experiment ($P \leq 0.05$). When the groups were evaluated among themselves, they showed different values and results and these effects were insignificant ($P \leq 0.05$). When the egg shell weight criteria were examined during the whole trial period, a difference was found at the end of the experiment ($P \leq 0.05$). Roche color range consisting of 15 slices of color was used throughout the trial period.

When egg yolk color criteria were examined during the trial period, there was no significant difference between the groups in terms of egg color criteria ($P \leq 0.001$). The average period of egg white height is given in Table 3. Significant differences were found at the end of the experiment ($P \leq 0.05$). The *Haugh unit* was not affected by the trial treatments, but the values obtained were not significantly different the 8th week treatments ($P \leq 0.05$). As a result, when the *Haugh Unit*, which is one of the egg quality criteria in the 8th week, is seen as the lowest in the K group with 85.25, it is seen that the highest is in the A1 group with 92.13 value.

Table 4. The effect of different processed barley on egg fatty acids of laying hens egg yolk

In the study, the effect of attack-hens on egg fatty acids fed with different processed barley and enzyme- weighted feeds during the total trial period is given in Table 4. When Table 4 was examined, no significant difference was found between the treatment of egg fatty acids such as *Heptadecanoic Acid, Cis- 10 Heptadecanoic, Cis- 11, 14- Eicosadienoic Acid and Tricosanoic Acid* ($P \leq 0.05$). But other egg fatty acids, *Pentadecanoic Acid, Linolelaidic* acid difference between the treatments ($P \leq 0.05$), *Arachidic Acid, Heneicosanoic Acid, Behenic Acid, Lignoceric Acid, Nervonic Acid, Cis - 4, 7, 10, 13, 16, 19 Doc Acid* was found to be very important differences in egg fatty acids ($P \leq 0.001$).

In the experiment omega 6 (n- 6) and omega 3 (n- 3) fatty acids are examined in terms of; *Linolelaidic acid* which is one of the omega 6 fatty acids was also found to be different between the treatments ($P \leq 0.05$). The lowest value in terms of *linolelaidic acid* was A3 group with 0, 022 and the highest value was A2 group with 0,046. However, there were significant differences in egg fatty acids such as *Linoleic Acid, gamma-Linolenic Acid* and *Cis- 11, 14- Eicosadienoic Acid* ($P \leq 0.001$). The lowest value in terms of linoleic acid was A6 with 18.11, and the highest value was

A2 with 27.47. It was found that there is a significant difference in egg fatty acids such as alpha-*Linolenic Acid* and *Cis- 4, 7, 10, 13, 16, 19 Doc Acid* which are *Omega 3 fatty acids* ($P \leq 0.001$).

Francech et al. [12], in the study conducted by high and low energy barley weighted (57% and 42%) egg hen ration of 80 and 160 ppm enzyme production in the 33- 44 weeks of age also increased egg yield, considering the whole yield period does not affect egg yield It has been reported. Anderson and Draper [13], barley ration fed groups, corn ration fed groups have reported lower egg production rates. In addition, Bustany et al. [14] stated that adding 72%- 75% of barley, wheat and rye to the mixed feeds in the total grain did not increase egg production. Benabdejelil et al. [15] and Ciftci et al. [16] reported that the addition of mixed enzyme to barley-containing egg rations does not affect egg production. Yıldız [11] examined weekly changes in the 36-46 week periods of chickens in gamma irradiation and it was observed that feeding with gamma irradiated barley or wheat had no significant effect on egg yield ($P \leq 0.05$). It was also observed that there was no difference between these groups and corn control group in terms of egg yield ($P \leq 0.05$). As a result of the trial; The feed consumption varied between 98.10- 107.31 g according to the groups and it was found to be statistically different ($P \leq 0.05$). According to the results; It was determined that feed consumption of 15% barley groups was high and feed consumption of 30% barley groups was low. In general, low feed consumption can be caused by the amount of barley added to the ration and the high temperatures during the experiment period. However, Francesh et al. [12] 57% and 42% barley containing the enzyme added to the egg feed at the end of the experiment reported that the increase of average egg weight. Francech et al. [12] in the study conducted by high and low energy barley weighted (57% and 42%) egg ration of 80 and 160 ppm enzyme added to the 20- 32 weeks of age increases the weight of the egg, it was reported that egg weight does not affect the whole yield period.

Yoruk and Bolat [10], corn and barley-based hen rations in order to investigate the effect of different enzyme additives on various yield properties in their study of 50% instead of corn as an energy source of barley rations with different enzyme additives were used to examine the amount of use. When weekly changes of egg yield are examined, it is seen that feeding with A1, A2, A3 groups, A4, A5, A6, A7 groups has no significant effect on egg yield. The highest egg yield was found in the A2 group with the highest 71.64% and the K group with the lowest 70.13%. In general, there was no difference between the groups in terms of egg yield. When the effect of different processed barley and multi enzyme addition on egg weight was examined, it was found that the highest egg weight was obtained from A2 (62.98 g) chickens and the lowest egg weight was obtained from A1 (56.45 g) chickens. Although the findings were generally consistent with the literature, they were found to have different results. The use of enzymes to laying hen rations do not have significant effect on egg quality criteria, while Fairfield et al. [17] found that the use of wheat and triticale with or without enzyme at different levels increased the shape index, although it did not lead to a change in shell thickness compared to the control group.

The *Haugh unit* was not affected by the trial procedures, but the values obtained were not based on the values given in the Turkish Standard Institute's natural egg class scale. When the *Haugh Unit*, which is one of the egg quality criteria in the 8 th week, is seen in the K group with the lowest 85.25, it is seen that the highest is in the A1 group with 92.13. In the experiment, omega 6 (n- 6) and omega 3 (n- 3) fatty acids; *Linolelaidic acid,* one of the omega 6 fatty acids, was also found to differ between treatments. The lowest value in terms of *linolelaidic acid* was A3 group with 0.022 and the highest value was A2 group with 0,046. There was a significant difference between oleic acid and egg fatty acids ($P \leq 0.05$). Shafey et al. [18], in the study conducted by the egg rations used in cereal grains (wheat, triticale, rye) and soybean oil (0 and 20 g/ kg) egg yield, egg yolk

cholesterol amount and the effect of egg yolk fatty acid composition was emphasized. As a result of the study, there was no difference between groups in terms of egg yolk cholesterol content, feed consumption, egg weight, egg yolk *palmitic*, *stearic* and *oleic acid* contents. Compared to the other two groups, the amount of *linoleic acid* was higher in the egg yolk of the chickens fed with triticale. *oleic acid/ linoleic acid* ratio was lower. Soybean oil used in rations increased egg yield, egg yolk linoleic acid and unsaturated fatty acid/ saturated fatty acid ratio while decreasing *oleic acid/ linoleic* acid ratio.

Alvarez et al. [19], *conjugated linoleic acid* (*CLA*) and sunflower oil with high oleic acid in a study on the effect on performance and egg quality in egg hens *conjugated linoleic acid* (*CLA*) (2 g/ kg) *monounsaturated fatty acid* in egg yolk (*MUFA*) increased *polyunsaturated fatty acids* (*PUFA*). High *oleic acid* sunflower oil (30 g/ kg) added to the diet increased the amount of *monounsaturated fatty acid* (*MUFA*) in egg yolk. In addition, *conjugated linoleic acid (CLA*) acid added to the diet increased the moisture and strength of the egg yolk. There was a significant difference between *oleic acid* and egg fatty acids ($P \leq 0.001$). It is thought that rations containing 30% barley, which increase this difference, may have influenced the amount of extra fat added to the ration.

4. Conclusion

It was studied effects of technological processes and the effects of enzymes were compared by adding multi enzyme additive on laying hens. There was no significant difference in mean egg yield between treatments in a result of variance analysis. When egg weight average was examined, it was found that egg weight was higher than A4 group weight ratios when A7 group added weighted ration was considered ($P \leq 0.01$). When we examined the omega-6 (n- 6) and omega- 3 (n- 3) fatty acids in the trial, Linolelaidic acid, one of the omega 6 fatty acids, was found to differ

between treatments ($P \leq 0.05$). The lowest value for linolelaidic acid ranged from 0.022 to A3 group, while the highest value was 0.046 to A2 group. As a result, the use of 30% heat- treated or multi- enzyme added barley in egg poultry rations has no negative effect on egg yield, egg quality and egg fatty acids, and 30% heat - treated barley or multi- enzyme added barley was successfully It can be used.

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Conflict of Interest

The author declared that no conflict of interest exists.

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Table 1. Feed ingredients of experimental diets and their nutrient analysis

Feed Ingredient(%)	K	A1	A2	A3	A3	A5	A6	A7
Barley	0	15	15	15	30	30	30	30
Corn	55.20	40,6	40,6	40,6	26,6	26,6	26,6	26,6
Soybean Meal-47	22	23	23	23	23,50	23,50	23,50	23,50
Sunflower meal-35	8.4	5,8	5,8	5,8	3,53	3,53	3,53	3,53
Vegeteble oil	2.8	4	4	4	5	5	5	5
Limestone	8.17	8.17	8.17	8.17	8	8	8	8
Dicalsium Fosfat	2,6	2,55	2,55	2,55	2,55	2,55	2,55	2,52
Salt	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Lysine	0,03	0,05	0,05	0,05	0,025	0,025	0,025	0,025
Methionine	0,2	0,2	0,2	0,2	0,25	0,25	0,25	0,25
Premix*	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
Enzymes	-	-	-	-	-	-	-	0,025
TOPLAM	100	100	100	100	100	100	100	100
Calculated and analizsed Nutrients								
Dry Matter %	90,,6	90,,7	90,,7	90,,7	90,,8	90,,8	90,,8	90,,8
Crude Protein, %	17,,2	17,,2	17,,2	17,,2	17,,2	17,,2	17,,2	17,,2
ME, kcal/kg	2739	2739	2739	2739	2735	2735	2735	2736
Ca, %	3,,82	3,,82	3,,82	3,,82	3,,74	3,,74	3,,74	3,,74
Avaible ,P, %	0,,54	0,,55	0,,55	0,,55	0,,55	0,,55	0,,55	0,,55
Na, %	0,,15	0,,15	0,,15	0,,15	0,,13	0,,13	0,,13	0,,13
Met+Sis, %	0,,83	0,,82	0,,82	0,,82	0,,82	0,,82	0,,82	0,,82
Lizin, %	0,,84	0,,87	0,,87	0,,87	0,,88	0,,88	0,,88	0,,88
Treonin, %	0,,63	0,,63	0,,63	0,,63	0,,63	0,,63	0,,63	0,,63
Triptofan, %	0,,23	0,,24	0,,24	0,,24	0,,25	0,,25	0,,25	0,,25

* Vitamin-Mineral premix 1 kg in ration; 100 mg manganese, 60 mg iron, 10 mg copper, 0,20 mg cobalt, 1 mg iodine, 0,15 mg selenium; 12,000 IU of vitamin A, 1,500 IU of vitamin D, 30 mg of vitamin E, 5,0 mg of vitamin K, 3,0 mg of thiamine, 6,0 mg of riboflavin, 5,0 mg of pyridoxine, 0,03 mg of cyanocobalamine, 40,0 mg of nicotinamide, 10,0 mg of calcium D-pantothenate, 0,75 mg of folic acid, 0,075 mg D-biotin, 375 mg choline chloride, 10,0 mg antioxidant, * K; control group, A1; 15% Cracked barley, A2; 15% Pellet barley, A3; 15% Flake barley, A4; 30% Cracked barley, A5; 30% Pellet barley, A6; 30% Flake barley, A7; 30% Cracked barley + Enzyme (0,025%),

Table 2. Effects of using of laying hens rations different processed barley and suplemented multi enzymes on productive parameters of laying hens,

	Groups										
	*K	A1	A2	A3	A4	A5	A6	A7	SEM	P	O,S
Feed Intake g	102,65^{b}	105,73^{a}	107,31^{a}	103,14^{b}	102,92^{b}	98,10^{c}	99,46^{c}	99,32^{c}	7.785	0.0001	***
Egg yield %	70,13^{b}	70,87^{ab}	71,64^{a}	71,10^{ab}	71,51^{a}	70,68^{ab}	70,93^{ab}	70,82^{ab}	1,790	0.184	-
Egg weight g,	57,97^{bc}	56,45^{c}	62,98^{a}	59,28^{bc}	58,52^{bc}	57,15^{bc}	59,50^{abc}	60,41^{ab}	3.313	0,007	**
**Total egg weightkg	39,70^{cb}	40,36^{b}	41,95^{a}	39,02^{c}	37,22^{d}	38,84^{c}	40,68^{b}	41,76^{a}	1.900	0.0001	***

* K; control group, A1; 15% Cracked barley, A2; 15% Pellet barley, A3; 15% Flake barley, A4; 30% Cracked barley, A5; 30% Pellet barley, A6; 30% Flake barley, A7; 30% Cracked barley + Enzyme (0,025%), OS: Significantly Level, *: P< 0,05, **: P< 0,01, ***: P< 0,001, SEM: Standard Error Mean,

**Total egg weight obtained from the experiment

Table 3. The Effect of Using Different Processed and Multi-Enzyme Barley on Egg Quality

	GROUPS										
	K	A1	A2	A3	A4	A5	A6	A7	SEM	P	ÖS
Egg weight (g)	57,87^{a}	55,25^{a}	61,37^{a}	58,14^{a}	58,75^{a}	56,42^{a}	61,50^{a}	58,25^{a}	34,12	0,3302	-
Shape index	73,81^{a}	74,43^{a}	74,12^{a}	75,14^{a}	74,75^{a}	74,50^{a}	73,58^{a}	73,56^{a}	2,34	0,9577	-
Egg width (mm)	42,11^{a}	41,61^{a}	43,16^{a}	42,77^{a}	42,69^{a}	42,31^{a}	42,68^{a}	41,98^{a}	1,95	0,3465	-
Egg length (mm)	57,31^{ab}	56,65^{ab}	58,01^{a}	52,61^{b}	57,40^{ab}	57,18^{ab}	58,37^{a}	57,43^{ab}	22,56	0,3252	-
Strength (kg / cm^{2})	0,37^{a}	0,42^{a}	0,45^{a}	0,41^{a}	0,53^{a}	0,42^{a}	0,43^{a}	0,42^{a}	0,017	0,5974	-
Shell weight (g)	7,21^{abc}	7,03^{bc}	7,77^{ab}	7,85^{a}	7,14^{abc}	6,98^{bc}	6,84^{c}	7,65^{ab}	1,09	0,0321	*
Shell Thickness (mm)	0,29^{a}	0,31^{a}	0,30^{a}	0,33^{a}	0,32^{a}	0,30^{a}	0,29^{a}	0,31^{a}	0,001	0,6531	-
Color	10,75^{b}	10,87^{ab}	11,25^{ab}	11,14^{ab}	11,50^{ab}	11,57^{ab}	11,33^{ab}	11,87^{a}	1,07	0,2921	-
Height of yellow (mm)	19,85^{a}	18,33^{bc}	19,34^{ab}	18,49^{bc}	18,63^{bc}	18,20^{c}	18,12^{c}	18,49^{bc}	2,76	0,0030	**
Yolkindex (mm)	42,23^{a}	42,73^{a}	43,15^{a}	41,50^{a}	43,50^{a}	41,48^{a}	42,79^{ab}	42,38^{ab}	3,89	0,4201	-
Length of white (mm)	84,06^{a}	85,47^{a}	84,79^{a}	85,10^{a}	83,85^{a}	81,44^{a}	80,61^{a}	85,93^{a}	25,09	0,5609	-
White index index (mm)	67,15^{a}	68,50^{a}	69,80^{a}	65,62^{a}	66,24^{a}	64,67^{a}	66,02^{a}	66,64^{a}	20,49	0,6906	-
White height (mm)	7,19^{b}	8,27^{a}	7,89^{a}	8,07^{a}	7,76^{ab}	7,81^{a}	8,06^{a}	8,05^{a}	0,84	0,0226	*
Yellow weight (g)	15,55^{ab}	14,63^{b}	16,08^{b}	14,62^{b}	15,14^{ab}	14,69^{b}	15,26^{ab}	15,35^{ab}	2,00	0,0287	*
White weight (g)	35,37^{bc}	33,34^{c}	37,52^{ab}	35,51^{bc}	36,45^{ab}	35,03^{bc}	38,39^{a}	35,24^{bc}	17,78	0,0034	**
Haugh unit	85,25^{b}	92,13^{a}	88,37^{ab}	90,13^{a}	88,33^{ab}	89,29^{a}	89,30^{a}	90,09^{a}	31,05	0,0227	*

^{a,b,c,d} The same lines are different,

* K; control group, A1; 15% Cracked barley, A2; 15% Pellet barley, A3; 15% Flake barley, A4; 30% Cracked barley, A5; 30% Pellet barley, A6; 30% Flake barley, A7; 30% Cracked barley + Enzyme (0,025%),OS: Significantly Level, *: P< 0,05, **: P< 0,01, ***: P< 0,001, SEM: Standard Error Mean, Color: Roche color range consisting of 15 slices was used,

Table 4. Effect of Different Processed Barley on Egg yolk Fatty Acids of Laying Hens

	Groups										
	K	A1	A2	A3	A4	A5	A6	A7	SEM	P	ÖS
Myristic Acid	0,520^{a}	0,457^{c}	0,388^{d}	0,389^{d}	0,571^{a}	0,440^{c}	0,525^{b}	0,383^{d}	0,01	0,0001	***
Myristoleic Acid	0,034^{c}	0,029^{c}	0,083^{a}	0,016^{d}	0,019^{d}	0,019^{d}	0,051^{b}	0,036^{c}	0	0,0001	***
Pentadecanoic	0,073^{abc}	0,068^{bc}	0,068^{bc}	0,085^{a}	0,077^{ab}	0,064^{bc}	0,058^{c}	0,071^{abc}	0	0,04	*
Palmitic Acid	28,14^{cd}	28,30^{c}	26,76^{e}	27,80^{d}	29,06^{b}	27,71^{d}	30,44^{a}	28,37^{c}	2,33	0,0001	***
Palmiteloic Acid	0,94^{bc}	1,08^{b}	0,85^{c}	0,89^{c}	0,86^{c}	1,74^{b}	1,59^{a}	1,60^{a}	0,19	0,0001	***
Heptadecanoic	0,274^{ab}	0,263^{ab}	0,252^{a}	0,303^{ab}	0,277^{ab}	0,256^{ab}	0,226^{b}	0,192^{b}	0,02	0,2378	-
Cis-10	0,040^{a}	0,063^{a}	0,180^{a}	0,059^{a}	0,044^{a}	0,046^{a}	0,046^{a}	0,065^{a}	0	0,45	-
Stearic Acid	17,96^{a}	15,53^{c}	14,94^{d}	13,96^{e}	16,52^{b}	14,93^{d}	16,03^{bc}	10,69^{f}	9,14	0,0001	***
Oleic Acid	26,88^{c}	30,33^{b}	25,26^{c}	26,85^{c}	23,19^{d}	25,90^{c}	29,48^{b}	35,41^{a}	28,61	0,0001	***
Linolelaidic acid	0,035^{ab}	0,038^{a}	0,046^{a}	0,022^{b}	0,044^{a}	0,041^{a}	0,032^{ab}	0,023^{b}	0	0,0206	*
Linoleic Acid (n-	21,63^{d}	20,53^{e}	27,47^{a}	25,82^{b}	25,73^{b}	23,41^{c}	18,11^{g}	19,25^{f}	23,12	0,0001	***
gama-Linolenic	0,097^{e}	0,093^{e}	0,112^{cd}	0,123^{b}	0,118^{bc}	0,200^{a}	0,121^{b}	0,108^{d}	0	0,0001	***
alfa-Linolenic	0,336^{d}	0,300^{e}	0,443^{b}	0,343^{d}	0,356^{d}	0,400^{c}	0,246^{f}	0,468^{a}	0,01	0,0001	***
Arachidic Acid	0,222^{e}	0,239^{d}	0,251^{c}	0,266^{b}	0,222^{e}	0,242^{d}	0,241^{d}	0,371^{a}	0	0,0001	***
Heneicosanoic	0,390^{d}	0,369^{e}	0,615^{a}	0,493^{b}	0,470^{c}	0,488^{bc}	0,308^{f}	0,370^{e}	0,01	0,0001	***
Cis-11,14-	0,206^{a}	0,153^{a}	0,207^{a}	0,180^{a}	0,162^{a}	0,235^{a}	0,197^{a}	0,397^{a}	0,01	0,558	-
Behenic Acid	1,238^{cd}	1,035^{f}	1,312^{b}	1,271^{bc}	1,152^{e}	2,036^{a}	1,220^{d}	1,307^{b}	0,183	0,0001	***
Tricosanoic Acid	0,023^{a}	0,029^{a}	0,358^{a}	0,023^{a}	0,029^{a}	0,032^{a}	0,035^{a}	0,021^{a}	0,027	0,485	-
Lignoceric Acid	0,656^{bc}	0,718^{b}	0,730^{b}	0,713^{b}	0,726^{b}	1,741^{a}	0,702^{b}	0,599^{c}	0,279	0,0001	***
Nervonic Acid	0,047^{d}	0,053^{c}	0,069^{b}	0,047^{d}	0,054^{c}	0,160^{a}	0,043^{e}	0,041^{e}	0,003	0,0001	***
Cis-13,16,19	0,239^{e}	0,247^{de}	0,262^{cd}	0,270^{c}	0,252^{cd}	0,506^{a}	0,246^{de}	0,411^{b}	0,019	0,0001	***

^{a,b,c,d} The same lines are different,

* K; control group, A1; 15% Cracked barley, A2; 15% Pellet barley, A3; 15% Flake barley, A4; 30% Cracked barley, A5; 30% Pellet barley, A6; 30% Flake barley, A7; 30% Cracked barley + Enzyme (0,025%),OS: Significantly Level, *: P< 0,05, **: P< 0,01, ***: P< 0,001, SEM: Standard Error Mean