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Kaposvári Egyetem, Állattudományi Kar, Kaposvár
University of Kaposvár, Faculty of Animal Science, Kaposvár

The effect of different levels of Acorn seeds (*Quercus branti*) on laying hens performance in first phase of egg production

A. [1]Saffarzadeh, L. [2]Vincze , J. [3]Csapó
[1]Natural Resources & Animal Husbandry Research Center of Khoozestan, Ahwaz, P.O.Box 613 35- 3341 Iran
[2]University of Veszprém, Georgikon Faculty of Agricultural Sciences Keszthely H-8361 Deák F. u.16.
[3]University of Kaposvár, Faculty of Animal Science, Kaposvár, H-7400 Guba S. u. 40.

ABSTRACT

The experiment was conducted over 12 weeks period with one hundred and sixty 24 weeks old white leghorn hens. Diets containing 0, 10, 20 and 30% acorn seeds of Quercus branti were given to caged laying hens in first phase of egg production (weeks 24-36). Egg weight, feed intake, mortality rate and body weight were not significantly affected by the treatments, but egg production rate, egg number, egg mass by P<0.01 and feed efficiency with P<0.05 were affected by the experimental diets. It could be concluded that treatment containing 30% acorn seeds significantly reduced egg production rate, egg number, egg mass, and feed efficiency in first phase of egg production (weeks 24-36). Acorn seeds could be used in the diet of laying hens in place of corn up to 20% with no serious adverse effects on performance.
(Keywords: laying hens, acorn seeds, *Quercus branti*, egg production rate, feed efficiency)

ÖSSZEFOGLALÁS

A különböző mennyiségű makk (*Quercus branti*) hatása a tojótyúkok termelésére a tojástermelés első szakaszában
[1]Saffarzadeh, A., [2]Vincze L., [3]Csapó J.
[1]Natural Resources & Animal Husbandry Research Center of Khoozestan, Ahwaz, P.O.Box 613 35- 3341 Iran
[2]Veszprémi Egyetem, Georgikon Mezőgazdaságtudományi Kar, Keszthely, 8361 Deák F. u. 16.
[3]Kaposvári Egyetem, Állattenyésztési Kar, Kaposvár, 7400 Guba S. u. 40.

A kísérleteket 12 héten keresztül, 160, 24 hetes fehér leghorn tojótyúkkal végezték. A takarmány a Quercus branti fajtájú makkból 0, 10, 20 ill. 30%-ot tartalmazott ketrecben tartott tojótyúkoknál, a tojástermelés első fázisában (24-36. hét között). A tojás súlyát, a takarmány felvételt, az elhullási arányt és a testtömeget nem befolyásolta szignifikánsan a makk részaránya, ezzel szemben a tojástermelési arányra, a tojások számára, tömegére P<0,01, a takarmányértékesítésre pedig P<0,05 szinten volt hatással a kísérleti takarmányok fogyasztása. A 30% makktartalmú takarmány szignifikánsan csökkentette a tojástermelési arányt, a tojások számát, tömegét és a takarmány-értékesítést a tojástermelés első szakaszában (24-36. hét). A makkot 20%-os arányig alkalmazni lehet tojótyúkok takarmányában minden káros következmény nélkül.
(Kulcsszavak: tojótyúkok, makk, *Quercus branti*, tojástermelési arány takarmányértékesítés)

INTRODUCTION

Feed is the major item of cost in the production of poultry meat and eggs, and energy sources have the highest ratio, in poultry diets. The highest energy sources for poultry nutrition is cereal grains, which is in competition with human food. Finding new energy sources, which are not in competition with human food, is very important. Acorn, which is the fruit of oak trees and provides from the forest, is new and nonconventional energy source. Acorn contains considerable amounts of tannin and other anti-nutritional substances. Rations with above 25% acorn meal produced eggs with coloured yolks and low hatchability (*Deboer et al.,* 1988). *Kaushal et al.* (1971) reported that incorporation of oak kernels at 5 percent level didn't affect the growth rate of chicks during 10-59 days of age. *Cicogena et al*. (1972) reported the result of a trial on the possibility of substituting maize by rice germ meal, acorns and denatured sugar, in diets for broilers. Satisfactory technical and economic results have been obtained only with the 1/3 substitution of maize. The total substitution of maize by the mentioned mixture produced broilers meat with better taste, but provided worse results for all other performance (growth rate, feed conversion, dressing percentage and feeding cost). The aim of this study is to investigate effects of substituting corn with acorn on laying hens performance and egg quality characteristics.

MATERIALS AND METHODS

Birds, housing and experimental design

One hundred and sixty 24 weeks old white leghorn hens were housed in cages located in two open-sided sheds, in double deck stair step cages. The dimension of each cage was 40 cm length, 37 cm width and 44 cm height, and two birds were placed to each cage. The experiment was conducted in the experimental henhouse of animal science research station of Dezful in Khoozestan province in the Iran.

Twelve weeks old pullets all of the same breeder flock from a commercial leghorn breeder stock was provided and raised on deep litter floor until 18 weeks old. The length of lightening during rearing of pullet was 10 hours with 14 hours dark pauses. At 18^{th} week of age the pullets were transferred to cages and were fed with immature leghorn-type chickens diets from 18 weeks old to first egg. The composition of pullet diet was formulated according the requirements (N.R.C. 1994), and is shown in *Table 1*.

The 24 weeks old laying hen were weighed and assigned to cages according to a randomized complete block design with four treatments and four replication in four independent separate blocks. Forty birds were randomly assigned to each treatment, and 10 laying hens were placed per replication or experimental unit, which include 5 cages and 2 laying hen were located in a cage.

The experiment was carried out over 12 weeks period, between 24 and 36 weeks of laying hens age, during first phase of egg production. The hens had access to feed and water adlibitum, and provided 17 hours lightening per day and 7 hours dark pauses. During the experimental period, the temperature of the henhouse was fluctuated between 16-24°C.

Diets

The composition of the experimental layer diet is shown in *Table 2*, and composition of premix is shown in *Table 3*. The control diet (TO) without acorn seeds, was based on

corn, soybean meal (44% protein) and fish meal (60% protein) as the principal sources of energy and protein, respectively. The experimental diets are following:

- *Treatment-0 (T0):* as control treatment diet based on corn, extracted soybean meal, fish meal and other supplement (basal diet).
- *Treatment-1 (T1):* The ingredients used for (T0)+10% acorn seeds.
- *Treatment-2 (T2):* The ingredients used for (T0)+20% acorn seeds.
- *Treatment-3 (T3):* The ingredients used for (T0)+30% acorn seeds.

Table 1

Composition of pullet diets in different ages

Ingredients & Composition (1)	12–18 week(2)	18 week to first egg (3)
Corn(4)	60	70
Soybean meal(5)	14	20
Fish meal(6)	3	4
Barley(7)	20	-
Oyster shell (8)	1.50	4.60
Dicalcium phosphate(9)	0.65	0.55
Salt(10)	0.35	0.35
Premix *	0.50	0.50
Calculated composition(11)		
MEN (Mj/kg)	12.27	12.15
Crude protein(12)	15.20	17.15
Ether extract(13)	3.03	3.20
Crude fiber(14)	3.42	2.97
Calcium(15)	0.80	2
Phosphorus(16)	0.30	0.33
Lysine(17)	0.74	0.90
Methionine(18)	0.28	0.31
Met+Cys(19)	0.54	0.59
Linoleic acid(20)	1.55	1.63

*The composition of Premix is shown in *Table 3.* (*A premix összetétele a 3. táblázatban látható.)*

1. táblázat: Különböző korú tojótyúkok takarmányának összetétele

Összetétel, alkotórész(1), Hetek(2), 18 héttől az első tojásig(3), Kukorica(4), Szójaliszt(5), Halliszt(6), Árpa(7), Kagylóhéj(8), Kalcium-hidrogén-foszfát(9), Só(10), Kalkulált összetétel(11), Nyers fehérje(12), Nyers zsír(13), Nyers rost(14), Kalcium(15), Foszfor(16), Lizin(17), Metionin(18), Metionin+cisztin(19), Linolsav(20)

Table 2

Composition of layer diets containing acorn seeds

Ingredients & Composition(1)	T0 Control diet(2)	T1 Acorn 10%(3)	T2 Acorn 20%(4)	T3 Acorn 30%(5)
Corn(6)	72	61	50	38.80
Soybean meal(7)	12.40	13.70	15	16.3
Fish meal(8)	4	4	4	4
Acorn(9)	-	10	20	30
Oyster shell (10)	6	4	3	3
Dicalcium phosphate(11)	0.20	0.20	0.20	0.20
Limestone(12)	5	6.30	7	7
Methionine(13)	0.06	0.08	0.10	0.12
Salt(14)	0.25	0.25	0.25	0.25
Premix *	0.50	0.50	0.50	0.50
Calculated composition(15)				
MEN (MJ/kg)	11.75	11.75	11.75	11.75
Crude protein (16)	14.50	14.50	14.50	14.50
Ether extract(17)	3.21	3.57	3.94	4.29
Crude fiber(18)	2.46	2.50	2.70	2.80
Calcium(19)	3.16	3.16	3.18	3.19
Phosphorus(20)	0.24	0.24	0.24	0.24
Lysine(21)	0.70	0.72	0.75	0.77
Methionine(22)	0.32	0.33	0.34	0.35
Met+Cys(23)	0.56	0.56	0.56	0.56
Linoleic acid(24)	1.60	1.55	1.47	1.38

*The composition of premix is shown in *Table 3*. (*A premix összetétele a 3. táblázatban látható.)*

2. táblázat: A tojótyúkok makktartalmú takarmányának összetétele

Összetétel, alkotórész(1), Kontroll diéta(2), 10% makktartalmú(3), 20% makktartalmú(4), 30% makktaralmú(5), Kukorica(6), Szójaliszt(7), Halliszt(8), Makk(9), Kagylóhéj(10), Kalcium-hidrogén-foszfát(11), Mészkő(12), Metionin(13), Só(14), Számított összetétel(15), Nyers fehérje(16), Nyers zsír(17), Nyers rost(18), Kalcium(19), Foszfor(20), Lizin(21), Metionin(22),Metionin+cisztin(23), Linolsav(24)

This acorn seeds was picked up from *Quercus branti* species which is famed Iranian oak or Zagrossian oak, and grow on Zgros mountain chains of Iran, in a area about 4 million hectares (*Sabeti,* 1994). In the all experimental diets containing acorn seeds was substituted with corn. The experimental diet were formulated according leghorn-type chicken requirements was noted in Nutrient Requirements of Poultry (N.R.C, 1994), and all diets were isocaloric and isonitrogenic.

The calculated nitrogen corrected apparent metabolisable energy (AMEn) content of the diets was 11.75 MJ/kg and crude protein was 145 g/kg. The ratio of energy to protein was 193.33 and the other nutrients content of the diets were balanced by this ratio. The experimental diets were ground and mixed weekly by a special miller and

mixer in the Animal Science Research Station of Dezful. Feed intake and remaining in feeder of each experimental unit were weighed weekly for determination feed consumption during week, every phases and finally whole period of experiment.

Table 3

Composition of vitamins and minerals premix *

Vitamin & Mineral(1)	Supplement(2)		Layer supplement(3)		**Breeder supplement(4)**	
Vitamin A	11000000	IU	10000000	IU	12000000	IU
Vitamin D_3	1800000	IU	2500000	IU	2200000	IU
Vitamin E	18000	IU	10000	IU	25000	IU
Vitamin K_3	2500	mg	2200	mg	3000	mg
Vitamin B_1	1500	mg	1000	mg	2000	mg
Vitamin B_2	6000	mg	4000	mg	6000	mg
Niacin	30000	mg	20000	mg	30000	mg
Vitamin B_3	12000	mg	8000	mg	14000	mg
Vitamin B_6	1500	mg	2000	mg	2000	mg
Vitamin B_9	1000	mg	560	mg	800	mg
Vitamin B_{12}	16	mg	15	mg	14	mg
Vitamin H_2 (Biotin)	100	mg	150	mg	100	mg
Choline chloride	550000	mg	400000	mg	500000	mg
Antioxidant	10000	mg	10000	mg	10000	mg
Iron (Fe)	50000	mg	50000	mg	40000	mg
Zinc (Zn)	65000	mg	60000	mg	60000	mg
Selenium (Se)	200	mg	100	mg	100	mg
Cobalt (Co)	100	mg	100	mg	100	mg
Copper (Cu)	5000	mg	5000	mg	5000	mg
Manganese (Mn)	100000	mg	80000	mg	100000	mg
Iodine (I)	1000	mg	1000	mg	1000	mg

*Each 5 kg of premix containing Vitamins and Minerals is shown in table and is used per 1ton ration. (*A táblázatban látható összetételű premixből 5 kg-t kevertek 1 t takarmányhoz*.)

3. táblázat: A vitamin és az ásványi premix összetétele

Vitamin és ásványi anyag kiegészítés(1), Kiegészítő(2), Tojókiegészítő(3), Tenyészkiegészítő(4)

Measurement and analyses

Egg production in each replicate group was recorded daily and the feed consumption was measured at 7 day intervals. All eggs were collected from each 16 replicate groups once a week intervals were weighed, and the average egg weight, weighted for the total number of eggs laid in each replicated group during one week and summarized in a phase for treatment. Egg number was recorded daily for each replicate groups and summarized in a phases per hen. Individual body weights were recorded at the start and end of this phase and was summarized at the end of each phases per replication and treatments. Feed consumption was recorded weekly for each replicate groups and summarized per hen per day.

Egg production percentage or rate of laying was calculated by dividing sum of egg number to sum hen day. Egg mass per hen per day (g) was calculated by multiplying mean egg weight (g) and egg production rate. Feed efficiency was calculated by dividing feed intake per hen per day in gram to egg mass per hen per day in gram. Mortality rate was recorded daily of

dead hen and summarized for first phase of egg production. All data for different parameters were recorded daily, weekly and summarized for first phase of egg production.

Statistical analysis

The data was subjected to analysis of variance (*Steel et al.,* 1980), and treatment means were compared by *Duncan's* multiple range test (*Duncan,* 1955). A statistical analysis of experimental results was made by the STATGRAPHICS (Statistical Graphics System), Version 5 and also Excel version 5 softwares.

RESULTS AND DISCUSSIONS

The performance data between 24 and 36 week of age (first phase of egg production) is presented in *Table 4.* Rate of egg production significantly influenced by dietary treatments. Treatments (T0-T3), (T1-T3) had significant differences by P<0.01 and treatments (T2) by P<0.05.

Table 4

Effect of dietary levels of acorn seeds on the laying performance between 24 and 36 weeks of age

Treats (1)	Rations contain acorn(2)%	Egg laying rate(3)%	Egg number 84 days(4) ±SD	Egg weight (g)(5) ±SD	Egg mass (g)/h/d (6) ±SD	Feed intake (g)/h/d(7) ±SD	F.C.E. (g)/ feed(g)(8) ±SD	Mortality rate%(9) ±SD	Body weight (kg) week 36(10) ±SD
T0	_	85.63 e ±1	71.72 a ±0.94	57.26 ±0.53	49.10 e ±0.45	110.62 ±2.80	2.27 a ±0.06	12.5 ±4.79	1.64 ±0.08
T1	10	86.58 e ±1.49	72.63ae ±1.28	57.58 ±0.18	49.89 e ±0.92	110.82 ±1.08	2.23 a ±0.06	7.5 ±2.5	1.54 ±0.06
T2	20	84.51 a ±1.38	70.82 a ±1.25	57.50 ±0.49	48.65 e ±0.78	112.36 ±2.89	2.32 ±0.04	7.5 ±4.79	1.60 ±0.04
T3	30	77.22bf ±2.02	64.79bf ±1.66	56.91 ±0.42	43.98 f ±1.20	108.57 ±2.65	2.50 b ±0.09	15 ±6.46	1.49 ±0.10
Mean ±SD S.L	_	83.48 ±0.76 **	70 ±0.66 **	57.31 ±0.21 NS	47.90 ±0.44 **	110.59 ±1.23 NS	2.33 ±0.03 *	10.63 ±2.42 NS	1.57 ±0.04 NS

F.C.E.: Feed conversion efficiency; T: Treatment; SD: Standard deviation; SL: significant level; NS: not significant; SL: *=P<0.05, **=P<0.1. (*F.C.E.: takarmány átalakítás hatékonysága, T: kezelés, SD: szórás, SL: szignifikancia szint, NS: nem szignifikáns*); Significant differences between the data being in the same column: P<0.05: a-b; c-d. P<0.01: e-f. (*Szignifikáns különbségek az ugyanazon oszlopba lévő adatok között.)*

4. táblázat: A takarmány makktartalmának hatása tojótyúkok teljesítményére 24 és 36 hetes életkor között

Kezelések(1), Makktartalom aránya(2), Tojás termelési arány(3), 84 nap alatti tojások száma(4), Tojások súlya(5), Tojásmassza tömege(6), Takarmány átalakítás hatékonysága(7), Takarmánybevitel(8), Elhullási arány (9), 36. hetes testtömeg(10)

Number of eggs per hen in 84 days was affected by dietary treatments. Treatments (T1-T3) by P<0.01 and treatments (T0-T3), (T2-T3) with P<0.05 were significantly affected by dietary treatments. Feed intake per hen per day, mean egg weight, mortality rate and body weight were not significantly P>0.05 affected by the dietary treatments.

Egg mass per hen per day had significant differences by P<0.01 between treatment (T0-T3), (T1-T3), (T2-T3). Feed [(g) feed intakeb/(g) egg mass], was shown significant differences by P<0.05 between treatments (T0-T3) and (T1-T3). In the all cases rate of egg production, number of eggs per hen in 84 days, egg mass per hen per day and feed efficiency was significantly affected by the dietary treatments. Especially treatment-3 (T3) containing 30% acorn was shown the worse results. These result could be due to high level (30%) of acorn and because tannin content of acorn (4.7%) in treatment-3 (T3).

This results is in agreement with the reports of *Sell et al*. (1989), and *Rogler et al.* (1984), who reported the tannin cause poorer egg production, and reduced amino acid or nitrogen digestibility (*Rostagno et al.,* 1973b; *Elkin et al*., 1978b; *Kirby et al*., 1983), and also is in agreement with the reports of *Chang et al.,* 1964; *Connor et al*., 1969; *Rostagno et al*., 1973a; *Armstrong et al*., 1973, 1974a,b; *Featherston et al.,* 1975; *Elkin et al*., 1978a,b, *Price et al*., 1978a, 1979; *Sell et al.,* 1983; *Rogler et al.,* 1984; *Garwood et al.,* 1987, who reported tannin reduced feed efficiency.

CONCLUSIONS

This investigation revealed for the first time that experimental diets containing different levels of dehulled acorn seeds were not shown significant effects on egg weight, feed intake, mortality rate, body weight, of laying hens, but egg production rate, egg number, egg mass and feed efficiency were affected significantly by experimental treatment diets in first phase of egg production (weeks 24-36). The significant differences due to the treatment containing 30% acorn. The results of this investigation confirm for the first time that in first phase of egg production (weeks 24-36) could be recommended using up to 20% dehulled acorn instead of corn in laying hens ration.

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Corresponding author (*levelezési cím*):

Ali Saffarzadeh
Natural Resources & Animal Husbandry Research Center of Khoozestan
P.O.Box: 613 35-3341 Ahwaz, Iran