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THE EFFECT OF ENSILED MAIZE GRAINS ON LAYING OF HENS

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ABSTRACT

In the feeding trial with 600 laying hens of ISA Brown provenance the effect of ensiled maize grains on laying was examined. The laying was monitored since the age 21 weeks. At the age 32 weeks from the flock of 1400 hens 600 animals were chosen at random and divided in six groups. Trial rations were started at age 40 weeks when the hens reached the peak production. The trial had lasted for 154 days when the laying capacity started to decrease considerably. Two maize hybrids Raissa and Lotus were compared. In the ration there were 40% of dry matter from ensiled grains or 60% respectively. Supplemental feeding mixture was equal in both cases. Control animals were fed with complete feeding mixture *ad libitum*. Other groups fed with silage as well as one group of laying hens fed with complete feeding mixture were given restricted rations. Results of laying before and during the trial were processed by statistical package SAS/STAT (1990). There were no significant differences between the hybrids. Groups with 40% dry matter from the silage had significantly lower laying than the control group, which can be explained by lower energy content. Groups with 60% of dry matter from the silage had better laying than the groups with less silage as well as better laying in comparison with the control groups. Groups with higher metabolic energy content in trial ration had better laying. Energy and protein consumption for egg production differed a lot between the groups due to different contents of protein and energy in the rations and, hence, to diverse number of laid eggs.

Key words: laying hens / laying / animal nutrition / feed / ensiled maize grains

UČINEK SILIRANEGA KORUZNEGA ZRNJA NA NESNOST KOKOŠI

IZVLEČEK

V krmilnem poskusu s 600 nesnicami izvora Isa Brown smo preskušali učinek siliranega koruznega zrnja na nesnost. Nesnost živali smo spremljali od 21. tedna starosti dalje. Pri 32. tednu starosti smo iz jate 1400 nesnic naključno odbrali 600 živali in jih razporedili v šest skupin. Preskusne obroke smo začeli pokladati pri 40. tednu starosti, ko so kokoši že dosegle vrh nesnosti. Preskus je trajal 154 dni, to je do časa, ko je začela nesnost občutno padati. Primerjali smo dva hibrida, Raisso in Lotus. V obroku je bilo 40 odstotkov suhe snovi iz siliranega zrnja oz. 60 odstotkov. Dopolnilna krmna mešanica je bila v obeh primerih enaka. Živali v kontrolni skupini smo krmili s popolno krmno mešanico po volji. Druge skupine, krmljene s silažo, in tudi eno skupino nesnic, krmljenih s popolno krmno mešanico, pa smo krmili odmerjeno. Rezultate nesnosti pred in med poskusom smo obračunali s statističnim paketom SAS/STAT (1990). Med hibridoma ni bilo značilnih razlik. Skupini s 40 odstotki suhe snovi iz silaže sta imeli značilno slabšo nesnost od kontrolne, kar razlagamo z manjšo vsebnostjo energije. Skupini s 60 odstotki suhe snovi iz silaže sta imeli značilno boljšo nesnost od skupin z manj silaže. Ti dve skupini sta imeli tudi boljšo nesnost kot kontrolni skupini. Preskusni skupini z večjo vsebnostjo presnovne energije v krmnem obroku sta dosegli boljšo nesnost. Poraba energije in beljakovin za prirejo jajc je po skupinah zelo različna zaradi različne vsebnosti beljakovin in energije v obrokih in zaradi različnega števila znesenih jajc.

Ključne besede: kokoši / nesnice / prehrana živali / krma / silirano koruzno zrnje

INTRODUCTION AND SURVEY OF LITERATURE

In Slovenia, many farmers have already decided for ecological food production. Eggs are certainly one of the more important food. Rations for laying hens composed of silage from home produced maize grains can contribute to more efficient rearing. On the Slovenian family farms, egg production is economically the least effective (Kavčič, 1998). Feeding poultry with silage from maize grains with cobs or without them is well known. Roth-Maier and Kirchgessner reported in 1983 about the results of including the silage from maize grains and cobs (CCM) into rations for laying hens. Silage affected neither the laying nor the average mass of eggs or daily egg mass, but the colour of egg yolk improved significantly. In the restricted feeding, there were 59.52% of dry matter (DM) from the silage in the ration. Feeding silage *ad libitum* did not give good results. Hens consumed a lot of silage and their body mass increased significantly. The average calculated content of apparent metabolic energy in the silage was 14.4 MJ kg^{-1} DM. Different degrees of grinding affected neither the content of energy (Roth-Maier and Kirchgessner, 1984a) nor the consumption (Roth-Maier and Kirchgessner, 1984b). Barth (1984) found out that at ensiling the maize grains with cobs for poultry the equated grinding was very important. Very fine grinding is not necessary, however particles should not measure less than 8 mm. The percentage of dry matter from the silage in the ration should be between 30% and 70%. He advised to mix the silage with supplemental mixture before feeding. Jeroch *et al.* (1985) reported on the trial with laying hens. In the ration, there were 63.12% of dry matter from the silage of grains and cobs. They found out a favorable effect of silage on the yolk colour. They advised to feed the hens twice a day with a ration, in which it did not have to be more than 60 g of crude fibre per kg of dry matter.

Abbas Sadek and Stekar (1985) measured the digestibility of silage from maize grain on female of breeders. At 50% of dry matter from the silage, the digestibility coefficient for organic matter from silage was 0.87. The incorporation of silage in a ration meant better digestibility of the whole ration. Sadek Abbas (1986) ascertained that a ration with 40% of dry matter from ensiled maize grains had better digestibility than a ration with 50%. He used female of breeders in his experiments. Those results were considered by Kmecl *et al.* (1987) who fed hens of the same type with rations that contained 36.80% of dry matter from ensiled maize grains. They found a significant difference between Haugh's units in eggs laid by hens fed with silage or without it respectively. Eggs laid by hens from trial groups with silage were of the best quality while the control group without silage achieved only the lowest level of the same quality. Berger (1988) fed laying geese with rations with different contents of dry matter from ensiled maize grains and cobs (15 to 60%). He found out that silage improved the laying, enlarged the egg mass and improved the fertility rate and hatchability as well. Higher percentage of silage even improved this effects.

Holcman *et al.* (1988) fed hens of broiler type with two trial rations with 36.57% of dry matter from ensiled maize grains and cobs and ensiled grains respectively. They found the best fertility and hatchability in the group with silage from maize grains following by the group with silage from maize grains and cobs. The worst fertility and hatchability was found in the control group that did not receive any silage in the ration.

Stekar *et al.* (1988a) fed female of breeders with a ration that contained 40% or 50% of dry matter from ensiled maize grains. They established that ensiled maize did not affect the laying but food consumption improved. The ration with 40% of dry matter from ensiled maize grains had significantly better the average (n = 6) digestibility of organic matter, crude protein, ether extract, crude fibre and nitrogen-free extractives (80.10; 60.07; 79.89; 22.59 and 92.67) in comparison with the ration (n = 6) that contained 50% of dry matter from ensiled grains (77.18; 55.17; 80.81; 9.60 and 91.95) and with the ration (n = 6) from complete feeding mixture (76.92; 51.96; 57.82; 10.71 and 90.90). The average digestibility of ensiled maize grains was high, at 40% it was 89.57; 78.32; 87.68; 53.52 and 93.02, and at 50% 79.98; 58.47; 86.45; 14.11 and 91.47. The average content of apparent metabolic energy of ensiled maize grains was 8.8 MJ kg^{-1} DM (Stekar *et al.,* 1998b).

In our study we wanted to investigate the effect of home produced ensiled maize grains in the rations for laying hens. In the trial we considered several parameters but we presented here only one of them.

MATERIAL AND METHODS

The plan of the trial

In the feeding trial the laying of hens grouped in six groups at 600 hens were compared. Hens in the experimental groups were fed food from ensiled maize grains and supplemental feeding mixture. Silage was fed in two proportions, with the first one 40% of dry matter and with the second proportion 60% of dry matter was contributed to the ration. Silage was prepared from two maize hybrids. We had two control groups. Both groups were fed with complete feeding mixtures, the first group was fed restricted rations while the second one was fed *ad libitum*. The first control group received the complete feeding mixture without any supplemented pigment.

The trial rations with 40% of dry matter from the silage contained less energy and more crude ash that the rations with 60% of dry matter from the silage. The rations were not balanced because of other objectives of the study. Table 1 shows the plan of the trial.

Table 1. The plan of the trial

Group	Ration (%) DM	Feeding
First	40 silage (Raissa) + 60 SFM [1]	restricted
Second	60 silage (Raissa) + 40 SFM	restricted
Third	40 silage (Lotus) + 60 SFM	restricted
Fourth	60 silage (Lotus) + 40 SFM	restricted
Fifth	complete feeding mixture [2]	restricted
Sixth	complete feeding mixture [3]	*ad libitum*

[1] supplemental feeding mixture, [2] no pigment supplemented, [3] pigment supplemented

The trial lasted 154 days. The animals reached the peak production at the beginning of the trial. The laying was monitored for 19 weeks before the beginning of the trial.

Animals

Hens of ISA Brown were included into the trial. They were reared on floor with straw. At age 12 weeks 600 animals were chosen at random from the flock of 1400 animals. They were put in the middle deck of three decked cages. In each cage there were 5 animals. The poultry house was artificially lighted with 5.68 Wm^{-2} . Day light lasted 16 hours, from 6 a.m. to 10 p.m. Side rifts and an aperture in the ceiling were used for aeration. All animals were vaccinated against Marek's disease, Gumboro disease and New castle disease. Animals were 40 weeks old at the beginning of the trial.

Feeding

After the caging till the beginning of the trial, i.e., from age 12 weeks to age 40 weeks, all trial animals were equally fed. The complete feeding mixture for pullets was used until age 18 weeks following by complete feeding mixture for laying hens. Hens were fed *ad libitum* all that time. During the trial, hens were fed restricted rations once a day always at the same time and by hand. The trial rations were prepared every day. The amount of daily ration was calculated for each group so that each animal received 106 g of dry matter a day. Animals in the first and the third group (40% DM from silage) received 134 g of food a day, while in the second and fourth group 143 g (60% DM from the silage). Hens from the fifth group received 120 g of food a day. The rests of food were weighted.

Water was posed by nipples from hanging valve at the edge of each cage.

Preparing of silage

In the trial the effect of two maize hybrids Raissa and Lotus were compared. Raissa is a dent and two-line hybrid from FAO 345 class. The Pionner's ensures the resistance to *Ostrinia nubilalis Hbn*. and *Helminthosporium turcicum Pass*., high fertility and a good quality of grain.

Lotus is half flint and a result of one line crossing from FAO 280 class. The Nikerson's ensures resistance to *Ustilago maydis /DC/ Cda*. and stalk rupture.

Maize was produced at home. It was harvested at the end of October. At harvesting grains were ground obtaining 5 mm particles. The chemical composition of fresh ground grains is shown in Table 2. Grains were analyzed in the laboratory of Agricultural Institute Maribor.

Table 2. Chemical analysis of fresh ground maize grain, g kg $^{-1}$ DM

	RAISSA	LOTUS
Dry matter, g kg^{-1}	678.90	684.40
Crude protein	94.30	82.50
Crude fibre	41.20	37.70
Crude ash	14.40	12.00
Ash insoluble in HCl	0.00	0.00
Crude fat	32.70	32.00
N-free extractives	817.40	835.80

Fresh ground maize grains were ensiled without any additives in a tower silo with the diameter of 3.0 m, and 2.5 m high. The inside of the silo was divided into quarters with wooden barriers so that hybrids were ensiled separately each in two quarters. Ground maize grains were pressed, covered with foil and weighted with sand. After 70 days we started to feed the silage.

Preparing the rations

Rations for four groups of hens that were fed with silage were prepared in the concrete-mixer. Weighted amounts of silage and supplemental feeding mixture were mixed for 20 minutes. Before the trial the homogeneity of mixing was checked. The wanted time of mixing was found out on the base of chemical analysis of rations with different time of mixing: 15 and 20 minutes.

The samples of food were analyzed in the chemical laboratory at Zootechnical Dept. of Biotechnical Fac. Table 3 shows the result of determination of crude ash contents in the trial rations after 20 minutes of mixing and in two parallels. Food was sampled from each quarter of the mixer separately.

Table 3. Content of crude ash in the trial rations, g kg^{-1}

Ration	First		Second		Third		Fourth	
Sample	1	2	1	2	1	2	1	2
Quadrant 1	197.57 197.62	169.81 176.18	116.73 130.17	105.56 94.75	193.86 177.15	192.58 178.04	119.04 120.59	118.48 108.64
Quadrant 2	152.60 166.02	153.66 154.76	106.34 106.67	95.87 84.61	169.26 156.78	191.31 174.88	90.25 104.82	73.61 99.65
Quadrant 3	169.58 170.60	164.88 191.78	127.54 126.81	129.24 125.76	154.28 166.61	180.27 177.97	119.13 128.12	109.87 112.62
Quadrant 4	186.52 189.79	196.54 213.96	94.47 95.73	120.54 129.51	199.53 199.23	174.93 193.02	124.78 127.99	118.65 146.44
Average	178.79	177.70	113.06	110.73	177.09	182.88	116.84	111.00

Results showed a sufficient homogeneity.

The raw material composition of supplemental feeding mixture is presented in Table 4, and the composition of complete feeding mixture in Table 6. Hens in the control group were fed complete feeding mixture. The group fed *ad libitum* had some pigment added into the mixture while the group with restricted feeding regime did not.

Table 4. Raw material composition of supplemental feeding mixture

Components	Percentage
Soyabean meal	52.74
Meat meal	10.00
Limestone	22.90
Min.-vit. mixture	6.00
Wheat feeding meal	8.27
Flavour - vanilla	0.09

The supplemental feeding mixture was fed to all trial groups of laying hens regardless the percentage of ensiled maize grains in the ration.

The complete feeding mixture was prepared in the industrial mixing unit twice during the trial, first at the beginning of the trial and when the animals were 48 weeks old (Table 7).

The following table shows the contents of nutrients in the complete feeding mixture.

Table 5. Tabled composition of supplemental feeding mixture

Dry matter, g kg^{-1}	915.79	P, g kg^{-1}	15.27	Lysine, g kg^{-1}	17.82
Crude protein, g kg^{-1}	300.00	Ca, g kg^{-1}	110.00	Methionine, g kg^{-1}	7.61
Crude fat, g kg^{-1}	21.58	Mg, g kg^{-1}	1.14	Cystine, g kg^{-1}	4.57
Crude fibre, g kg^{-1}	51.00	Na, g kg^{-1}	4.73	Threonine, g kg^{-1}	11.14
Crude ash, g kg^{-1}	271.62	Fe, mg kg^{-1}	87.00	Tryptophan, g kg^{-1}	4.27
Nitrogen-free extractives, g kg^{-1}	200.64	Mn, mg kg^{-1}	300.00	Vit. A, IE kg^{-1}	45000.00
Digestible crude protein, g kg^{-1}	279.44	Zn, mg kg^{-1}	165.00	Vit. D_3, IE kg^{-1}	5400.00
Total nutrients	538.73	Cu, mg kg^{-1}	19.80	Vit. E, mg kg^{-1}	45.00
Metabolic energy, MJ kg^{-1}	7.57	I, mg kg^{-1}	2.40	Vit B_1, mg kg^{-1}	6.00
Nicotinic acid, mg kg^{-1}	108.00	Co, mg kg^{-1}	0.90	Vit. B_2, mg kg^{-1}	18.00
Ca pantothenat, mg kg^{-1}	36.00	Se, mg kg^{-1}	0.45	Vit. B_6, mg kg^{-1}	6.00
Holyne chloride, mg kg^{-1}	1800.00	B_{12}, mg kg^{-1}	0.05	Biotin, mg kg^{-1}	0.60
Folic acid, mg kg^{-1}	1.50	K_3, mg kg^{-1}	12.00	Flavour, g kg^{-1}	1.00
Antibiotic, g kg^{-1}	0.02	Antiox., g kg^{-1}	0.42	-	-

Table 6. Raw material composition of complete feeding mixture

Components	Percentage
Maize	58.12
Barley	6.00
Lucerne meal	7.00
Wheat bran	3.00
Soyabean meal	11.93
Limestone	7.44
Meat-bone meal	2.50
Fish meal	2.50
Mono calcium phosphate	0.66
Premix PN KB pigment - F	0.50
Salt	0.35

Table 7. Tabled composition of nutrients in the complete feeding mixture, %

Nutrients	Mixing		Nutrients	Mixing	
	first	second		first	second
Dry matter	88.88	88.88	Total nutrients	58.97	59.62
Crude protein	16.00	16.00	Metabolic energy, $MJkg^{-1}$	11.69	11.56
Crude fat	4.21	3.75	Lysine	0.74	0.76
N-free extractives	53.85	54.00	Methionine	0.33	0.34
Crude fibre	3.72	3.97	Methionine + Cystine	0.62	0.63
Crude ash	11.10	11.16	Threonine	0.60	0.62
Calcium	3.40	3.40	Tryptophan	0.19	0.19
Phosphorus	0.60	0.60	Phenylalanine + Tyrosine	1.20	1.21
Sodium	0.16	0.16	Phosphorus, usable	0.34	0.33
Digestible crude protein	10.75	11.14			

Statistical data processing

The results of laying in the period before the trial and during the trial were processed by the statistical package SAS/STAT (1990) using two models.

The first model was used to compare the laying among the groups of laying hens aged 32 to 39 weeks:

$$y_{ij} = \mu + S_i + b_I(t_{ij} - 35) + b_{II}(t_{ij} - 35)^2 + e_{ij}$$

y_{ij} = laying
μ = mean value
S_i = group; i = 1-6
b_I, b_{II} = coefficient of regression
t_{ij} = influence of week
e_{ij} = residue

The second model was used to compare the laying capacity during the feeding trial. The influence of week and rations was considered. Both hybrids were included in rations.

$$Y_{ij} = \mu + S_i + b(t_{ij} - 50) + e_{ij}$$

y_{ij} = laying
μ = mean value
S_i = ration, i = 1-6
b = coefficient of regression
t_{ij} = influence of week
e_{ij} = residue

RESULTS AND DISCUSSION

Chemical analyses

All chemical analyses except the amino acids were performed in the chemical laboratory at Zootechnical Dept. of Biotechnical Fac.

Ensiled grains from both hybrids were analyzed three times during the trial, first at the beginning of the trial. Both silages differed neither in composition nor in quality (Table 8).

Table 8. Chemical analysis of ensiled maize grains, g kg^{-1} DM

	RAISSA			LOTUS		
Date of sampling	8th Jan.	12th Jan.	16th Apr.	8th Jan.	12th Jan.	16th Apr.
Dry matter, g kg^{-1}	631.44	667.26	676.59	644.82	670.18	673.76
Crude protein	90.55	90.91	82.79	84.98	87.04	85.72
Crude fat	38.39	39.37	41.62	40.88	41.91	41.02
Crude fibre	25.83	22.27	16.70	28.79	23.62	18.65
Crude ash	15.80	16.58	15.48	12.91	13.45	14.89
N-free extractives	829.43	830.87	843.41	832.44	833.98	839.72
Lactic acid	5.56	5.53	9.84	7.30	6.27	10.30
Acetic acid	5.64	5.50	3.95	5.37	3.67	3.04
Propionic acid	0.24	0.36	0.00	0.56	0.28	0.03
Butyric acid	0.25	0.46	0.62	0.98	0.45	0.24
Flieg's estimation	3(42)	4(32)	3(52)	4(28)	4(40)	2(76)
Ammonia	0.41	0.39	0.46	0.51	0.49	0.46
pH value	4.38	4.39	4.17	4.14	4.24	4.09

The amino acid composition of lyophilized samples of both silages, were analyzed in the Central Laboratory at Faculty of Pannonia Agricultural University, Animal Breeding Sciences in Kaposvar, Hungary (Table 9).

Contrary to our expectations there were no differences in amino acid composition of both hybrids.

Chemical composition of supplemental and complete feeding mixture are shown in tables 10 and 11, of experimental rations in table 12.

Table 9. Contents of amino acids in the ensiled maize grains

Amino acid	RAISSA		LOTUS	
	g/100 g sample	g/100g protein	g/100 g sample	g/100g protein
Aspartic acid	0.55	6.6	0.49	5.9
Threonine	0.29	3.4	0.28	3.4
Serine	0.37	4.5	0.37	4.5
Glutamic acid	1.40	16.8	1.49	17.9
Proline	0.76	9.1	0.86	10.3
Glycine	0.41	5.0	0.42	5.0
Alanine	0.61	7.3	0.66	7.9
Cystine	0.10	1.0	0.11	1.0
Valine	0.47	5.7	0.34	4.1
Methionine	0.09	1.1	0.13	1.5
Isoleucine	0.32	3.9	0.33	3.9
Leucine	1.13	13.6	1.20	14.4
Tyrosine	0.34	4.1	0.32	3.8
Phenylalanine	0.52	6.2	0.49	5.8
Lysine	0.22	2.7	0.23	2.7
Histidine	0.28	3.3	0.26	3.2
Arginine	0.30	3.6	0.22	2.7
Ammonia	0.15	1.8	0.12	1.4
Total	8.31	100.0	8.35	100.0
N% x 6.25	8.4		8.4	
Dry matter	96.2		96.3	

Table 10. Chemical composition of supplemental feeding mixture, g kg^{-1} dry matter

Date of sampling	13^{th} Feb.	16^{th} Apr.
Dry matter, g kg^{-1}	932.61	939.71
Crude protein	316.69	316.85
Crude fat	28.02	34.76
Crude fibre	54.70	67.73
Crude ash	407.06	289.08
N-free extractives	193.53	291.58
Phosphorus	16.72	18.05
Calcium	122.04	127.25

Table 11. Chemical analyses of feeding mixtures, g kg^{-1} dry matter

	Complete feeding mixture[1]		Complete feeding mixture[2]	
Date of sampling	15th Jan.	16th Apr.	15th Jan.	16th Apr.
Dry matter, g kg^{-1}	893.89	906.81	895.62	903.65
Crude protein	188.41	181.20	180.02	195.01
Crude fat	39.95	41.37	40.06	40.52
Crude fibre	41.65	51.32	41.29	49.08
Crude ash	126.76	113.10	130.97	124.33
N-free extractives	603.23	613.01	607.66	591.06
Phosphorus	7.90	7.31	7.71	7.94
Calcium	40.26	33.83	43.19	40.66
$ME_{N\text{-}kor}$ MJ kg^{-1}	15.38	15.45	15.31	15.31

[1] no pigment, [2] with pigment, $ME_{N\text{-}kor}$ $MJkg^{-1}$ = calculated according to Kirchgessner (1997)

Table 12. Chemical composition of trial rations, g kg^{-1} dry matter

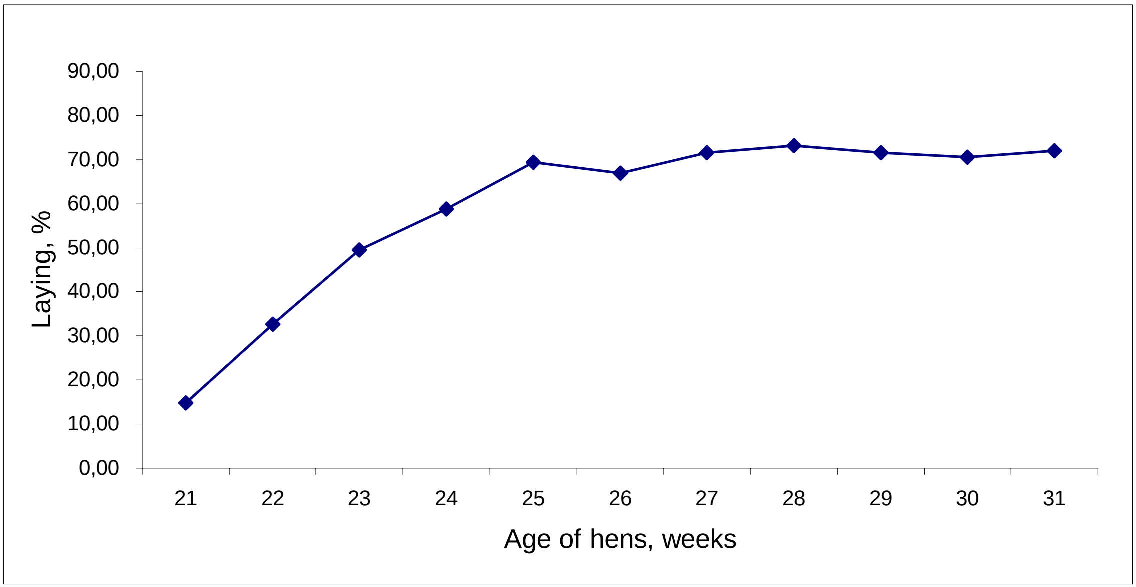
Rations	I		II		III		IV	
Date of sampling	15th Jan.	16th Apr.	15th Jan.	16th Apr.	15th Jan.	16th Apr.	15th Jan.	16th Apr.
Dry matter, g kg^{-1}	793.45	793.90	742.90	754.80	794.64	807.25	750.63	761.03
Crude protein	238.81	227.51	159.69	180.30	236.14	220.67	188.68	179.49
Crude fat	28.83	37.06	31.25	38.00	30.62	36.71	32.38	39.08
Crude fibre	40.91	53.38	32.64	41.54	41.65	49.03	33.73	36.61
Crude ash	236.47	198.43	156.95	140.26	243.6	232.28	160.02	163.14
N-free extractives	454.98	483.62	583.47	599.90	447.99	461.31	585.19	581.68
Phosphorus	11.56	11.72	8.84	9.14	11.53	12.35	8.55	9.26
Calcium	79.13	62.72	54.54	49.43	85.27	81.45	58.76	54.29
$ME_{N\text{-}kor}$ $MJkg^{-1}$	13.29	13.53	14.18	15.09	13.19	13.37	14.78	14.81

$ME_{N\text{-}kor}$ $MJkg^{-1}$ = calculated according to Kirchgessner (1997)

Laying

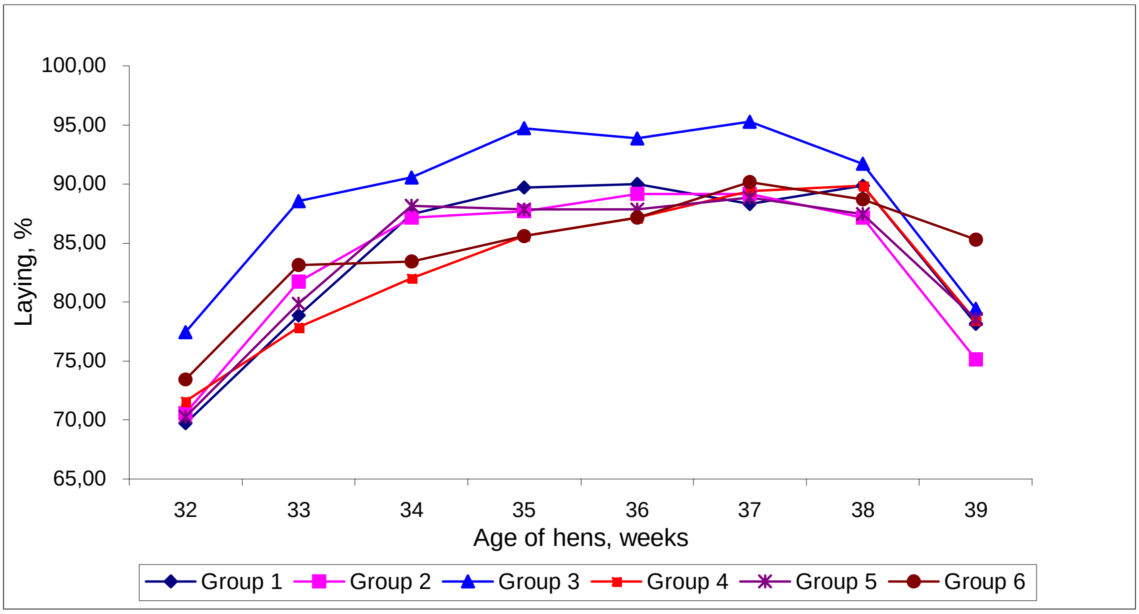
Pre-trial period

The laying at the age 21 weeks was 14.9%, and at the age 31 weeks 72.0%. In the first week of the mentioned period each hen laid on average 1.04 eggs, while in the week before the classification of hens into groups 5.04 eggs were laid on average a week. Graph 1 presents the increase of laying.



Graph 1. Laying curve in the pre-trial period, n = 1400.

After the formation of groups, when hens were 32 weeks old, the laying capacity was monitored in each group. During the pre-trial period animals were fed with commercial complete feeding mixture for laying hens *ad libitum* until the hens were 40 weeks old and the trial started. Graph 2 presents the laying capacity for each group.



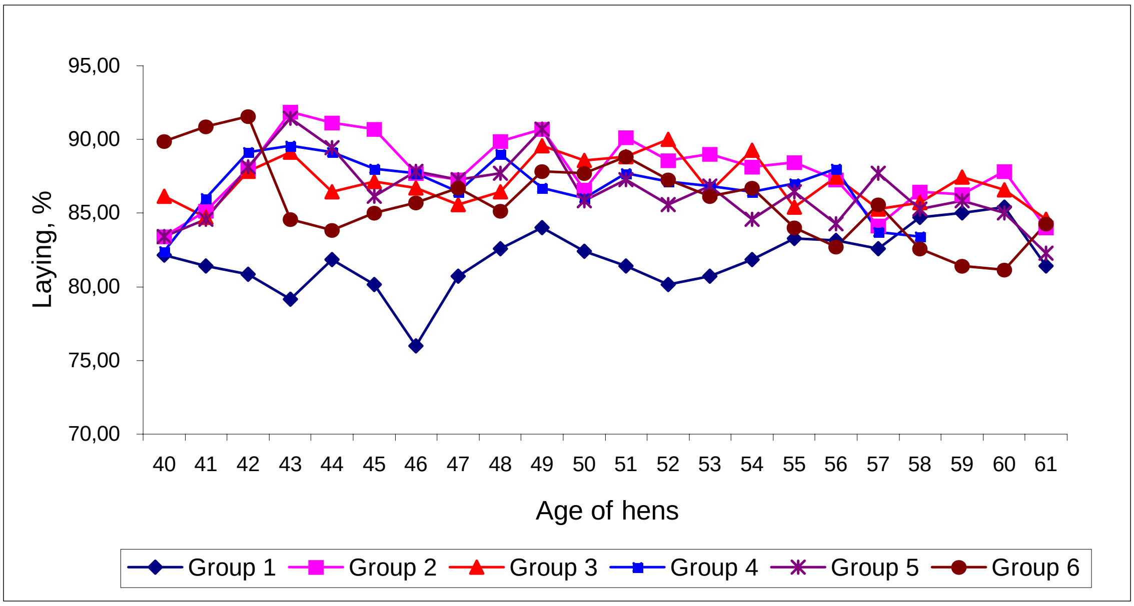
Graph 2. Laying curve for each group in the pre-trial period.

Graph 2 shows that the laying hens from the third group laid the highest number of eggs. This finding was considered in the statistical processing for the trial period.

On average each animal laid 5.88 eggs a week in the first group, 5.84 eggs in the second group, 6.22 eggs in the third group, 5.79 in the fourth group, 5.85 eggs in the fifth group and 5.92 eggs in the sixth group. In the last pre-trial week the number of laid eggs per hen continually decreased due to considerable temperature fall outside. Statistical calculations corrected for the 35th week of age of laying hens showed significant differences in laying capacity among weeks (P= 0.001) and among groups (P= 0.001). The third group exceeded the others for more than 5 percent on average.

Trial period

At the beginning of the trial period the laying was not balanced, it varied between 82.14% and 89.86% (Graph 3). The result of decreased laying before the trial was lower number of eggs in the trial period. Each hen laid on average 5.73 eggs a week in the first group, 6.15 eggs in the second group, 6.09 eggs in the third group, 6.07 eggs in the fourth group, 6.05 eggs in the fifth group and 6.01 eggs in the sixth one. In the calculations the laying was corrected to 50th week of age of hens. The laying from the pre-trial period was considered except the layings from 34th to 38th week. Statistical calculations showed that there were differences among the weeks of laying (P= 0.001).



Graph 3. Laying curve for each group in the trial period.

Statistically significant differences existed also among groups (P= 0.001). Precisely, hens from the first and third group that were fed with 40% of dry matter from silage in a ration laid less eggs (P = 0.001) than hens from the control group fed *ad libitum* during the trial. The same results were observed after the comparison with the fifth group in which the animals were fed restricted rations. Hens from the first group laid 6.32% less eggs and the hens from the third group and 5.19% less than laying hens from the control group fed *ad libitum*. In comparison with the control group fed restricted rations we noticed that they laid 5.85% and 4.72% respectively less eggs. The achieved results can be explained by the fact that rations with less silage contained less energy than rations with highest percentage of ensiled grains. The same can be said for both restricted rations.

The laying in the second and fourth group, in which hens were given 60% of dry matter from the silage per ration, did not significantly differ from the laying of the control group fed *ad libitum*, however the laying capacity of the hens from these two groups was for 0.80% and 0.96% better. Their laying was also better for 1.27% and 1.42% respectively than the laying of the control group fed restricted rations. The difference between the laying of hens in the control group fed restricted rations and the laying of both groups fed with 60% of silage was not significant yet it is close to it (P = 0.0373; P = 0.0194).

There were no significant differences among the control groups. Nevertheless, hens fed *ad libitum* laid for 0.46% more eggs than hens fed with restricted rations. Hybrids did not influence the laying significantly. However hens that were fed with silage made from Raissa grains laid for 0.64% less eggs than hens fed with ensiled Lotus grains.

There was a significant difference between the rations with 40% of dry matter from silage and rations with 60% of dry matter from silage (P= 0.001). Hens fed with 40% of dry matter from silage laid 6.64% less eggs, which can be explained by lower energy value of the ration.

Food consumption

In the trial period the amounts of consumed food per group were monitored (Table 13). Chemical analyses of food and data of food consumption were used to calculate the consumption of protein and energy.

Table 13. The average food consumption, g

Groups	Daily food consumption per hen		Food consumption per egg	
	g of food	g DM	g of food	g DM
First	134.00	107.67	163.70	131.53
Second	140.10	105.03	159.46	119.55
Third	134.00	107.96	154.02	124.09
Fourth	138.72	104.42	159.97	120.42
Fifth	120.00	108.04	138.84	125.00
Sixth	123.00	110.66	143.26	128.89

Laying hens in the first and third group that were fed with 40% of ensiled maize grains in dry matter consumed all given food every day. A daily ration weighted 134 g for each hen and it contained 107.67 g resp. 107.96 g DM (Table 13). The second and fourth group obtained 60% of dry matter from the silage in a ration. Each animal had 143 g of food a day but they did not eat all of it. Residues were weighted every week and we noticed that hens from the second group consumed 140.10 g resp. 105.03 g DM each and in the fourth group only 138.72 g resp. 104.42 g DM. In the fifth group each hen received 120 g or 108.04 g DM of complete feeding mixture with no pigments. There were no residues. Hens in the sixth group were fed *ad lib.* with the complete commercial feeding mixture. Each animal consumed on average 123 g of food a day resp. 110.66 g DM. The calculation of consumed amount of dry matter is based on results of chemical analyses shown in Tables 8, 10 and 11.

Food consumption per egg differed from groups. Hens from the first group that consumed all rations consumed the highest amount of food per egg, 163.70 g. The lowest amount of food per egg, 138,84 g was consumed by hens in the control group fed restricted. In the second and fourth group hens consumed the lowest amounts of dry matter per egg 119.55 g resp. 120.42 g. The animals in the third group consumed 124.00 g DM per egg, in the fifth group 125.00 g, in the sixth 128.89 g, and the highest amount of dry matter was consumed by hens from the first group, 131.53 g.

Table 14. Average daily consumption of metabolic energy and crude protein

Groups	Metabolic energy in ration MJ kg^{-1} DM	Daily consumption per hen		Consumption per egg	
		kJ ME	Crude protein, g	kJ ME	Crude protein, g
First	12.38	1333	25.10	1628	30.67
Second	13.86	1485	19.74	1691	22.47
Third	12.08	1304	24.66	1499	28.34
Fourth	13.69	1431	19.22	1650	22.17
Fifth	14.30	1545	19.97	1788	23.10
Sixth	14.18	1570	20.75	1827	24.17

Rations contained very small amounts of crude fibre and so lignin. Therefore the lignin was not considered when the contents of metabolic energy in the ration (Table 14) were calculated or quoted (World's Poultry Science Journal, 1983).

The first and third groups of hens were fed with rations containing 12.38 and 12.08 MJ kg^{-1} DM respectively. They consumed less energy per day (1333 kJ and 1304 kJ respect.) while the consumption of crude protein per laying hen was the highest (25.10 g and 24.66 g respect.) Rations with more silage in the dry matter fed in the fourth and fifth group contained more energy (13.86 and 13.69 MJ kg^{-1} DM respect.) and less protein (Table 12). In those groups each animal consumed 1485 kJ or 1431 kJ of metabolic energy per day and 19.74 g or 19.22 g crude protein. The rations of the control groups contained the highest amounts of metabolic energy with 14.30 or 14.18 MJ kg^{-1} DM. Each laying hen consumed 1545 kJ and 19.97 g of crude protein in the fifth group and 1570 kJ and 20.75 g of crude protein in the sixth group (Table 14).

Energy and protein consumption for egg production differed a lot between the groups due to different contents of protein, energy and elements in the rations and, hence, to diverse number of laid eggs.

The least energy for egg production was consumed by hens from the third group (1499 kJ per egg) and the most by the sixth control group that was fed *ad lib.* (1827 kJ per egg). Laying hens in the fourth group consumed the least (22.17 g) and the first group hens the most (30.67 g) of crude protein per egg.

CONCLUSIONS

- Ensiled maize grains can be successfully included into rations for laying hens.
- Hens like ensiled maize grain.
- Rations should be prepared every day.
- On the farms maize silage can be fed if hens are fed by hand.
- Results show that ensiled ground maize grains can replace dry maize grains.
- When there were 40% and 60% of dry matter from the silage in a ration, the results of laying could be compared with the laying of hens fed complete commercial feeding mixture. However, groups whose rations contained more energy, had higher laying capacity.

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