EAAP 2009, 60th Annual Meeting, Barcelona, Spain, Section S.34: Livestock Farming Systems Free Communications,
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PRODUCTIVITY OF THE LAYING HYBRIDS REARED IN DIFFERENT HUSBANDRY SYSTEMS

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ABSTRACT

The pressure exerted by the animals welfare organizations led to the establishment of certain new rearing systems for laying hybrids. However, these new systems do not always provide the optimal conditions for expressing the best yielding potential of the hens.

The biological material comprised 4698 Lohmann Brown hybrids, randomly allocated in 5 groups: a control group (Lc), which comprised hens reared within classical cages battery (500cm^2/hen) and 4 experimental groups: L_1exp (rearing in modified battery=1000cm^2/hen); L_2exp (rearing in opened panels batteries=500cm^2 in the nesting+resting cage and 500cm^2 in the cage with feeding and water devices); L_3exp (rearing on floor, permanent layer=0.17m^2/hen) and L_4exp (rearing on floor, permanent layer=0.13m^2/hen and access to an external paddock =2.0m^2/hen).

During the 60 weeks of laying, the fowl in the classical battery (Lc) achieved a production of 325.05 eggs/hen which was 2.68-15.89% higher than those of the experimental groups. The yield level generated the feed conversion ratio values, which were 6.89-38.32% lower in Lc, comparing with the experimental groups. Casualty incidence was influenced by the amount of hens per surface unit, reaching just 7.46-11.61% in the experimental groups, comparing to 11.66% in the Lc group.

The superintensive system (classical cages batteries) provides to the hybrids the better technological conditions, materialized in higher yield responses. Although the other rearing alternatives provide better welfare conditions, they also decrease the technical performances that could be achieved on the surface built unit.

Keywords: laying hybrids, alternative husbandry system, yield, welfare

INTRODUCTION

Husbandry of laying hens within the superintensive system, using battery cages, brought forth negative reactions from the animal science specialist, mainly among the members of the animal protection associations (2).

Consequently, an E.U. regulation stipulates that from 2012 the classic battery cages should be compulsive replaced by improved cages or, better, with other alternative rearing system (1).

Most of the technological versions used till now as alternatives to the superintensive fowl husbandry system are in accordance with the welfare requirements (5, 8), although some of them significantly affect the efficacy of the rearing areas optimal usage, while others do not provide the condition required by the exteriorization of the yield potential possessed by the used hybrid (6, 7). Moreover, other technological versions expose the fowl to some hazardous risks, such as contacting certain diseases from the rearing environment (3, 4).

Knowing these facts, the goal of this paper was to assess the yield response of the “Lohmann Brown” laying hen hybrid, reared within several different versions of the alternative systems, with horizontal and vertical disposing.

MATERIALS AND METHODS

The investigations have been carried on using 4698 hens, belonging to the “Lohmann Brown” commercial hybrid, which have been randomly allocated to 5 experimental groups that differed through the applied husbandry system and technology, as it follows:

- **Lc group** = hens reared within the superintensive system, using standard batteries with cages of 2000 cm^2 each, which hosted 4 hens, meaning a surface of 500cm^2 cage floor/hen;
- **L_1exp group** = hens reared within the intensive system, using cages with modified dimensions (surface = 6000 cm^2) each hosting 6 hens, providing thus 1000cm^2 cage floor/hen;
- **L_2exp group** = hens reared within the intensive system, using a compartment endorsed with two battery lines, disposed front to front, having a permanent layer of minced hay between. The cages from one battery line served as nesting+rest areas, providing 500cm^2/hen, while the cages from the another battery

line served for feeding and water intake, the same are being provided for each hen (500 cm^2). The front wired panels were removed from each cage, allowing this the freedom of movement for the fowl, across the entire compartment;

- **L_3exp group** = hens reared in accordance with the classic intensive system, with husbandry equipments disposed at soil, on permanent layer, assuring a density of 6 hens/m^2. the floor have been covered with permanent layer whom thickness reached 15 cm, then the equipments have been intercalated placed – feeders and watering devices; nests have been placed along the walls, on two levels;
- **L_4exp group** = fowl reared in semi-intensive husbandry system, which mixed the permanent layer system elements with the free access to the external paddock. The assured density reached 7.5 hens/m^2. The internal endorsement has been similarly organized as in the L_3exp compartment. The fowl had also access to the external paddocks, through 4 (four) small doors. The devices designed for feeding and water intake have been placed both inside and outside, under the paddock area protected by a small roof *(tab. 1)*.

The researches lasted de 60 weeks, from the 20th week of flock life till the 80th, inclusively, while the main morphoproductive indices have been assessed.

ACHIEVED RESULTS

1. Body weight dynamics. At the experiment onset, meaning at 20th week of flock age, the weight was fond within the standard interval of the hybrid (1583-1679g), being comprised between 1586.49 g (L_1exp group) and 1593.04 g (L_3exp group). As flock turned old, the body weight followed an increasing trend, with differences between groups, given by the lower or higher movement conditions as well as by the laying intensity of the fowl. The weights at the end of the experiment (80th week) were relevant, reaching: 1949.99 g in L_4exp group; 1953.89 g in L_3exp group; 2030.29 g in L_2exp group; 2083.03 g in L_1exp group and 2125.13 g in Lc group *(tab. 2)*.

2. Eggs yield. The “Lohmann Brown” hybrid is designed to produce 330-340 eggs/hen, during 14 weeks of usage. In the situation we studied, the highest yield, meaning 325.05 eggs/hen, has been observed in the fowl accommodated in classic cages (Lc group). These have been followed by the hens reared in dimensional modified cages (L_1exp group) – 316.32 eggs/hen, by those accommodated in opened panels cages (L_2exp group) – 311.24 eggs/hen, by the hens reared on permanent layer (L_3exp group) – 283.48 eggs/bird and also by the hens reared into the compartment with permanent layer which allowed access to the external paddock (L_4exp group), which produced 273.40 eggs/hen only *(tab. 3)*.

3. Laying intensity that could be achieved by the “Lohmann Brown” hybrid during 60 weeks of laying has an average value of 80.11%. In our research, the average laying intensity during age period of 20-80 weeks was of 77.41% at the fowl reared in classical batteries (Lc), of 75.34% at those accommodated in modified cages (L_1exp), of 74.16% at the hens reared in opened cages (L_2exp), of 67.29% at the birds reared on permanent layer (L_3exp) and just 64.89% at the hens having access at the external paddock (L_4exp).

The fowl in the 5 groups reached the maximum level of laying intensity within the optimal timing, during the 28th week of life. However, its level was found under the “Lohmann Brown” hybrid potential (93%), reaching 91.56% in Lc group, 89.88% in L_1exp group, 88.35% in L_2exp group, 78.11% in the L_3exp group and just 75.33% in the L_4exp group *(tab. 3)*.

4. The feed intake has been obviously influenced by the movement conditions, induced by the applied husbandry system. Thus, during the entire experimental period (20-80 weeks), the most convenient levels of the feed consumption (112.63 g/hen/day-average intake and 145.34 g/egg-feed conversion ratio) were calculated for the hens in the Lc group, reared within the superintensive system, which used standard cages. At the opposite pole were situated the hens reared in the semiintensive system (L_4exp), in the compartment having access to the external, meaning an average feed intake of 129.96 g/hen/day and a feed conversion ratio of 201.03 g/egg.

Between these two extremes, there were found the performances of the L_1exp group (116.47 g/hen/day-average intake; 155.35 g/egg-feed conversion), of the L_2exp group (120.51 g/hen/day-average intake; 164.38 g/egg-feed conversion) and of the L_3exp group (125.95 g/hen/day-average intake; 188,74 g/egg-feed conversion).

5. Flock casualties have been influenced by the fowl density on the surface unit and varied in accordance with the applied rearing system. The lowest casualty values were observed in the L_2exp – 7.46% - rearing technology using “opened panels batteries”. Close value has been observed in the L_4exp group (rearing on permanent layer, in the hall with permanent layer and access to the external paddock – 7.57% mortality, then in the L_1exp group (modified cages) – 8.22% mortality. The highest mortality levels have been observed in the fowl form the L_3exp group, reared on permanent layer (11.61%) respectively at those from the Lc group, accommodated in standard cages (11.66%) *(tab. 4).*

Usually, the mortality rate of the "Lohmann Brown" hens should be comprised between fill in the 4-6% limits, across the 60 weeks of exploitation.

CONCLUSIONS AND ADVISORY

Although the achieved values filled in the standard curve for the body weight of the „Lohmann Brown" hybrid, the ***fowl body weights*** were near the maximal admitted limit for those hens having less movement area (Lc group) respectively near to the minimal admitted limit at those hens having access to the external paddock (L_4exp group).

The highest ***eggs yield***, meaning 325.05 pcs./hen has been achieved by the hens reared within the superintensive system (unmodified battery-Lc group), being thus 2.68-15.89% higher than that of the values observed at the hens in the other experimental versions (groups L_1exp-L_4exp).

Comparing to the hybrid standard, ***the average laying intensity*** reached by the studied fowl was just 2.7% lower for the hens reared in classic cages (Lc) and 4.77-15.22% lower at those exploited in the other different versions of the alternative systems (groups L_1exp-L_4exp). The ***highest value of the laying intensity*** **was found under the theoretic performances of the** "Lohmann Brown" hybrid (93%), being thus 1.44% lower in the Lc group and 3.12-17.67% lower in the experimental ones (L_1exp-L_4exp).

Feed intake has been correlated with the achieved laying intensity, as well as with the assured fowl density per surface unit. Thus, the best performances were observed at the hens in the Lc group (rearing in classic battery), which had an average feed intake of 112.3 g/hen/day and a feed conversion ratio value of 145.34 g/egg. In the experimental groups (L_1exp-L_4exp), the average feed intake was 3.41-15.39% higher, while the FCR values passed over 6.89-38.92% the values achieved by the hens in the Lc group.

Concerning the ***flock casualties***, the acquired data revealed better results for the technological solutions applied in the experimental groups (L_1exp-L_4exp), whose mortality rates were 0.05-4.20% lower than that observed at the hens reared in classical cages batteries (Lc group).

The previously enounced conclusions proved that for the actual social and economic conditions in Romania, it imposes to still use the superintensive system in laying hens husbandry, meaning the classic type cages, being in fact that technological version providing the highest yield level and the most effective usage of the production areas.

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Table 1

Experimental design

Notice	Group				
	Lc	L_1exp	L_2exp	L_3exp	L_4exp
Husbandry system	Super-intensive	Intensive	intensive	intensive	Semi-intensive
Husbandry technology	in batteries with classic cages	in batteries, with enlarged cages	in opened batteries	on permanent layer	on permanent layer with access to external paddock
Accommodation facilities	108 cages	72 cages	-108 cages for laying and rest -108 cages for feeding and water intake	hall with permanent layer	hall with permanent layer + external paddock
Dimensions of accommodation facilities	length=40cm width=50cm	length=120cm width=50cm	length=40cm width=50cm	length=25.2m width=10.0m	length=25.2m width=10.0m
Husbandry surface	2000 cm^2/cage	6000 cm^2/ cage	2000 cm^2/cage 2000 cm^2/cage	252 m^2/hall	252 m^2/hall
Brooding flock size	432 capitis	432 capitis	432 capitis	1512 capitis	1890 capitis
Surface provided/hen	500 cm^2	1000 cm^2	-500 cm^2/cage for laying+rest -500 cm^2/cage for feeding and water intake	0.17m^2	0.13 cm^2
Studied traits	Body weight (g)				
	Eggs production (eggs/hen; % of laying)				
	Feed consumption (average intake-g/hen/day; feed conversion-g/egg)				
	Flock casualties (mortality %)				

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Table 2

Body weight dynamics (g) of the studied fowl

Fowl age (weeks)	**Standard body weight** (g)	Lc (n=100)		L_1exp (n=100)		L_2exp (n=100)		L_3exp (n=100)		L_4exp (n=100)	
		$\bar{X} \pm s_{\bar{X}}$ (g)	V%	$\bar{X} \pm s_{\bar{X}}$ (g)	V%	$\bar{X} \pm s_{\bar{X}}$ (g)	V%	$\bar{X} \pm s_{\bar{X}}$ (g)	V%	$\bar{X} \pm s_{\bar{X}}$ (g)	V%
20	1583-1679	1587.82±24.93	11.17	1586.49±35.63	15.98	1587.22±35.96	16.12	1593.04 ± 15.61	9.74	1591.12 ± 14.22	8.88
22	1727-1853	1730.57±30.08	12.29	1748.80±39.31	16.17	1714.45±43.50	17.94	1734.88 ± 18.18	10.48	1732.11 ± 17.42	10.06
24	1786-1954	1802.39±33.55	13.16	1794.37±43.29	17.06	1789.06±43.83	17.32	1793.02 ± 22.31	12.44	1790.37 ± 21.45	11.98
26	1805-1995	1845.81±37.28	14.28	1839.36±45.11	17.34	1833.39±42.76	16.49	1814.06 ± 25.23	13.91	1809.45 ± 23.05	12.74
28	1815-2006	1901.69±40.86	15.19	1868.58±45.01	17.03	1859.40±45.37	17.25	1824.28 ± 25.08	13.75	1821.18 ± 23.95	13.15
30	1824-2016	1935.44±41.72	15.24	1902.99±47.48	17.64	1870.98±48.93	18.49	1832.57 ± 29.17	15.92	1830.53 ± 26.94	14.72
32	1829-2021	1940.89±41.65	15.17	1911.89±47.56	17.59	1885.74±47.50	17.81	1837.79 ± 29.61	16.11	1834.88 ± 28.69	15.64
34	1834-2027	1946.38±43.74	15.89	1917.07±47.23	17.42	1894.62±55.71	20.79	1843.12 ± 30.19	16.38	1840.06 ± 29.27	15.91
36	1838-2032	1958.25±42.07	15.19	1922.37±51.63	18.99	1898.21±54.53	20.31	1850.18 ± 30.36	16.41	1846.74 ± 29.77	16.12
38	1843-2037	1984.48±46.01	16.39	1938.13±51.37	18.74	1907.39±55.52	20.58	1854.22 ± 30.48	16.44	1851.61 ± 30.95	16.72
40	1848-2042	1993.33±45.79	16.24	1956.70±51.42	18.58	1912.01±55.28	20.44	1857.17 ± 30.79	16.58	1854.30 ± 31.73	17.11
42	1853-2048	2002.33±45.48	16.06	1963.49±51.82	18.66	1919.08±56.05	20.65	1862.93 ± 31.43	16.87	1859.82 ± 32.53	17.49
44	1857-2053	2009.40±46.33	16.30	1970.27±52.25	18.75	1923.74±54.93	20.19	1867.34 ± 34.00	18.21	1863.07 ± 33.35	17.90
46	1862-2058	2012.02±45.99	16.16	1979.21±52.46	18.74	1930.63±57.70	21.13	1871.89 ± 37.47	20.02	1868.44 ± 35.76	19.14
48	1867-2063	2016.38±45.66	16.01	1984.38±55.79	19.88	1937.29±59.29	21.64	1875.91 ± 39.60	21.11	1872.22 ± 38.16	20.38
50	1872-2069	2019.41±48.21	16.88	1987.79±61.32	21.81	1941.30±57.74	21.03	1882.74 ± 40.44	21.48	1879.65 ± 39.25	20.88
52	1876-2074	2023.86±49.79	17.39	1991.11±61.87	21.97	1952.41±61.97	22.44	1886.11 ± 41.00	21.74	1882.13 ± 39.82	21.16
54	1881-2079	2027.17±49.32	17.20	1997.25±60.28	21.34	1959.58±61.78	22.29	1889.74 ± 41.23	21.82	1885.68 ± 40.13	21.28
56	1886-2084	2030.84±52.19	18.17	2001.73±61.55	21.74	1964.62±64.27	23.13	1893.84 ± 42.19	22.28	1890.45 ± 41.12	21.75
58	1891-2090	2035.75±52.93	18.38	2009.69±61.65	21.69	1970.89±66.09	23.71	1899.17 ± 42.37	22.31	1895.17 ± 41.48	21.98
60	1895-2095	2039.11±53.67	18.61	2014.57±63.87	21.75	1977.33±66.81	23.89	1906.86 ± 43.02	22.56	1902.21 ± 42.02	22.09
62	1900-2100	2044.74±52.75	18.24	2020.29±60.18	21.06	1985.27±66.44	23.66	1909.41 ± 43.17	22.61	1905.74 ± 42.57	22.34
64	1905-2105	2048.91±54.71	18.88	2025.14±61.81	21.58	1991.11±66.41	23.58	1912.32 ± 43.18	22.58	1908.36 ± 42.71	22.38
66	1910-2111	2056.89±59.29	20.38	2028.03±63.51	22.14	1994.29±64.99	23.04	1916.02 ± 44.39	23.17	1912.41 ± 43.20	22.59
68	1914-2116	2064.34±59.24	20.29	2035.21±63.58	22.09	2001.37±67.63	23.89	1921.43 ± 45.13	23.49	1917.83 ± 43.36	22.61
70	1919-2121	2071.93±59.19	20.20	2039.33±64.35	22.31	2008.74±65.82	23.17	1925.33 ± 45.40	23.58	1922.02 ± 43.99	22.89
72	1924-2126	2077.17±61.37	20.89	2044.24±65.49	22.65	2011.24±68.33	24.02	1933.33 ± 45.84	23.71	1929.11 ± 44.64	23.14
74	1929-2132	2084.22±62.46	21.19	2050.16±64.35	22.19	2014.23±69.26	24.31	1935.48 ± 46.06	23.80	1932.89 ± 44.84	23.20
76	1933-2137	2092.18±62.32	21.06	2059.77±66.02	22.66	2021.98±68.81	24.06	1941.25 ± 46.30	23.85	1937.02 ± 45.48	23.48
78	1938-2142	2108.12±71.23	23.89	2074.59±64.99	22.15	2025.22±71.09	24.82	1946.38 ± 46.54	23.91	1941.88 ± 46.10	23.74
80	1943-2147	2125.13±69.71	23.19	2083.03±66.90	22.74	2030.29±69.64	24.25	1953.89 ± 47.22	24.17	1949.99 ± 46.70	23.95

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Table3

Eggs yield (eggs/hen) and the laying intensity (%) of the studied hens

Week	Lc				L1exp				L2exp				L3exp				L4exp			
	Average flock size (capitis)	Total yield	% laying	Eggs/ hen (cumulated)	Average flock size (capitis)	Total yield	% laying	Eggs/ hen (cumulated)	Average flock size (capitis)	Total yield	% laying	Eggs/ hen (cumulated)	Average flock size (capitis)	Total yield	% laying	Eggs/ hen (cumulated)	Average flock size (capitis)	Total yield	% laying	Eggs/ hen (cumulated)
20	431.5	1154	38.2	2.67	431.5	1136	37.61	2.63	431	1115	36.96	2.59	1500.5	3529	33.60	3.24	1884.5	4275	32.41	3.12
21	431	1753	58.10	6.74	431	1725	57.17	6.63	430	1694	56.28	6.53	1495	5275	50.41	6.77	1882	6408	48.64	6.52
22	431	2261	74.91	11.98	431	2225	73.75	11.79	429.5	2184	72.64	11.61	1491.5	6580	63.02	11.18	1880.5	7997	60.75	10.77
23	430.5	2503	83.06	17.79	431	2463	81.64	17.50	429	2418	80.52	17.25	1489.5	7449	71.44	16.18	1879.5	9058	68.85	15.59
24	430	2642	87.79	23.93	431	2600	86.18	23.53	429	2552	84.98	23.20	1488	7878	75.63	21.47	1879	9591	72.92	20.69
25	429.5	2689	89.44	30.19	431	2646	87.70	29.67	429	2598	86.51	29.26	1486.5	8041	77.28	26.88	1879	9803	74.53	25.91
26	429	2729	90.87	36.55	430.5	2685	89.10	35.91	429	2636	87.78	35.40	1485	8085	77.78	32.32	1879	9866	75.01	31.16
27	428.5	2731	91.05	42.92	429.5	2687	89.37	42.17	428.5	2638	87.95	41.56	1483	8092	77.95	37.78	1878.5	9884	75.17	36.42
28	427.5	2740	91.56	49.33	428.5	2696	89.88	48.46	428	2647	88.35	47.74	1481.5	8101	78.11	43.25	1877.5	9900	75.33	41.69
29	427	2722	91.07	55.70	428	2678	89.38	54.72	428	2629	87.75	53.88	1480.5	8077	77.94	48.70	1876.5	9873	75.16	46.95
30	426.5	2702	90.50	62.03	427.5	2659	88.85	60.94	427.5	2610	87.23	59.98	1480	8058	77.78	54.14	1875	9846	75.02	52.20
31	426	2688	90.14	68.34	427	2645	88.49	67.13	427	2696	86.85	66.06	1478.5	8033	77.62	59.57	1873.5	9815	74.84	57.44
32	426	2683	89.97	74.63	427	2640	88.32	73.31	427	2691	86.68	72.13	1476	8002	77.45	64.99	1872.5	9789	74.68	62.67
33	426	2648	88.80	80.84	426.5	2606	87.29	79.42	426.5	2657	86.65	78.12	1474.5	7967	77.19	70.39	1871.5	9752	74.44	67.88
34	425.5	2622	88.08	87.00	426	2580	86.52	85.48	425.5	2631	84.87	84.07	1473	7925	76.86	75.77	1870.5	9705	74.12	73.07
35	425	2617	87.66	93.16	426	2575	86.35	91.52	424.5	2626	85.01	90.02	1471	7879	76.52	81.13	1869	9654	73.79	78.24
36	424	2588	87.63	99.29	425.5	2560	85.95	97.54	423.5	2613	84.77	95.95	1469.5	7828	76.10	86.46	1867.5	9593	73.38	83.38
37	422.5	2578	87.44	105.41	424.5	2545	85.66	103.53	422.5	2498	84.46	101.86	1468	7777	75.68	91.76	1866	9531	72.97	88.49
38	421.5	2562	87.27	111.52	423.5	2534	85.48	109.51	421.5	2488	84.32	107.76	1466	7723	75.26	97.03	1864.5	9496	72.76	93.58
39	420.5	2538	87.04	117.61	422.5	2522	85.27	115.48	420.5	2475	84.08	113.64	1464.5	7672	74.84	102.27	1863.5	9414	72.17	98.63
40	420	2523	86.33	123.65	422	2498	84.56	121.40	419.5	2452	83.50	119.48	1463.5	7624	74.42	107.48	1862	9353	71.76	103.65
41	420	2492	85.82	129.66	421.5	2483	84.15	127.29	418.5	2437	83.19	125.30	1462	7574	74.01	112.66	1860.5	9292	71.35	108.64
42	420	2492	84.76	135.59	421	2453	83.24	133.12	418	2407	82.26	131.08	1459.5	7517	73.58	117.81	1860	9238	70.95	113.61
43	419.5	2470	84.11	141.47	420.5	2431	82.59	138.90	418	2385	81.51	136.76	1457.5	7464	73.16	122.93	1859.5	9183	70.55	118.55
44	419	2463	83.97	147.35	420	2424	82.45	144.67	418	2378	81.27	142.45	1456	7405	72.65	128.01	1858.5	9113	70.05	123.45
45	418.5	2424	82.74	153.14	420	2385	81.12	150.35	418	2340	79.97	148.04	1454	7343	72.15	133.06	1858	9050	69.58	128.32
46	418	2398	81.95	158.88	420	2360	80.27	155.97	418	2314	79.08	153.57	1451.5	7280	71.65	138.08	1857.5	8983	69.09	133.16
47	418	2376	81.20	164.56	420	2338	79.52	161.53	418	2292	78.33	159.05	1449	7217	71.15	143.06	1856	8914	68.61	137.96
48	417.5	2364	80.89	170.22	419.5	2337	79.24	167.08	417.5	2280	78.01	164.51	1446.5	7153	70.64	148.01	1854.5	8843	68.12	142.73
49	416.5	2346	80.53	175.86	419	2311	78.79	172.59	417	2268	77.69	169.96	1444	7090	70.14	152.92	1853.5	8776	67.64	147.46
50	416	2322	79.74	181.44	419	2285	77.90	178.04	417	2242	76.81	175.33	1442.5	7031	69.63	157.79	1852	8705	67.15	152.16
51	415.5	2307	79.32	186.99	419	2271	77.43	183.46	417	2229	76.36	180.67	1441	6973	69.13	162.63	1851	8637	66.66	156.83
52	414.5	2288	78.85	192.51	419	2252	76.78	188.83	416.5	2210	75.80	185.98	1439.5	6906	68.53	167.43	1851	8565	66.10	161.46
53	414	2558	77.91	197.96	418.5	2222	75.85	194.14	416	2181	74.89	191.22	1437.5	6838	67.96	172.19	1851	8491	65.53	166.05
54	414	2339	77.26	203.37	418	2204	75.32	199.41	415.5	2162	74.33	196.42	1434.5	6765	67.37	176.91	1850	8412	64.96	170.60
55	413.5	2218	76.63	208.73	418	2183	74.61	204.63	415	2141	73.70	201.58	1432.5	6696	66.78	181.58	1848	8329	64.39	175.11
56	413	2196	75.96	214.05	418	2161	73.85	209.60	415	2121	73.01	206.69	1430.5	6628	66.19	186.21	1846	8248	63.83	179.58
57	413	2172	75.13	219.31	417.5	2137	73.12	214.92	415	2098	72.22	211.75	1428	6557	65.60	190.80	1844	8166	63.26	184.01
58	413	2156	74.57	224.53	417	2121	72.66	220.00	415	2082	71.67	218.76	1426	6490	65.02	195.35	1842	8083	62.69	188.40
59	412.5	2131	73.80	220.70	417	2097	71.83	225.03	415	2059	70.95	221.76	1423.5	6420	64.43	199.86	1839.5	8000	62.13	192.75
60	411.5	2097	72.79	234.79	416.5	2064	70.79	229.98	415	2025	69.71	226.64	1420.5	6348	63.84	204.33	1836.5	7914	61.56	197.06
61	410.5	2072	72.11	239.84	416	2039	70.02	234.88	414.5	2002	68.99	231.47	1416	6261	63.17	208.75	1833	7815	60.91	201.32
62	409	2051	71.64	244.85	416	2018	69.29	239.73	414	1981	68.36	236.25	1412.5	6179	62.49	213.12	1829	7715	60.26	205.54
63	407	2026	71.11	249.83	415.5	1994	68.50	244.52	414	1957	67.53	240.98	1408	6093	61.82	217.45	1824.5	7614	59.62	209.71
64	405.5	2007	70.71	254.78	414.5	1975	68.07	249.28	413.5	1938	66.95	245.67	1404	6010	61.15	221.73	1820	7513	58.97	213.84
65	404.5	1967	69.47	259.64	413.5	1935	66.85	253.96	413	1898	65.65	250.28	1400	5927	60.48	225.96	1816	7414	58.32	217.92
66	403.5	1936	68.54	264.43	413	1905	65.89	258.57	413	1868	64.61	254.78	1396	5845	59.81	230.15	1812	7315	57.67	221.96
67	403	1912	67.78	269.17	413	1881	65.06	263.12	413	1844	63.78	259.24	1392	5763	59.14	234.29	1808	7216	57.02	225.95

68	402.5	1886	66.94	273.85	412.5	1855	64.24	267.61	412.5	1816	62.89	263.64	1388.5	5682	58.46	238.38	1804	7120	56.38	229.90
69	401	18853	66.01	278.47	411.5	1822	63.25	272.04	412	1790	62.07	267.98	1385.5	5605	57.79	242.43	1799.5	7020	55.73	233.80
70	399.5	1836	65.72	283.07	411	1807	62.81	276.43	412	1776	61.58	272.29	1382.5	5528	57.12	246.43	1795	6921	55.08	237.66
71	398	1800	64.61	287.59	410.5	1769	61.56	280.74	411.5	1739	60.37	276.52	1379.5	5442	56.36	250.37	1791	6814	54.35	241.46
72	396.5	1756	63.27	292.02	409.5	1728	60.28	284.96	410.5	1696	59.02	280.65	1376.5	5358	55.61	254.26	1787	6707	53.62	245.21
73	395.5	1726	62.34	296.38	409	1698	59.31	289.11	409.5	1667	58.15	284.72	1373.5	5274	54.85	258.10	1783	6601	52.89	248.91
74	394.5	1698	61.49	300.68	408.5	1671	58.44	293.20	408.5	1640	57.35	288.73	1370.5	5189	54.09	261.88	1778.5	6494	52.16	252.56
75	393.5	1655	60.08	304.89	407.5	1629	57.11	297.19	407.5	1599	56.06	292.65	1367.5	5106	53.34	265.61	1773.5	6386	51.44	256.16
76	392	1638	59.69	309.07	406.5	1612	56.65	301.15	406.5	1582	55.59	296.54	1364.5	5022	52.58	269.29	1769	6279	50.71	259.71
77	390.5	1581	57.84	313.12	405	1556	54.88	304.99	406	1527	53.73	300.30	1361.5	4940	51.83	272.92	1764.5	6173	49.98	263.21
78	389	1558	57.22	317.13	403	1533	54.34	308.79	405.5	1502	53.02	304.01	1358	4855	51.07	276.49	1760	6068	49.25	266.66
79	387	1541	56.88	321.11	401	1516	54.01	312.57	404	1489	52.62	307.69	1354	4773	50.36	280.01	1756	5964	48.52	270.06
80	385	1519	56.38	**325.05**	309	1495	53.53	**316.32**	402	1467	52.13	**311.34**	1349	4680	49.56	**283.48**	1752.5	5863	47.79	**273.40**

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Table 4

Feed consumption of the studied flock

Fowl age	Analyzed trait	Group				
		Lc	L_1exp	L_2exp	L_3exp	L_4exp
20-45 weeks (182 days)	Flock size (capitis)	425	426	425	1478.5	1872
	Feed intake (kg/group/period)	8224	8611	8909	34051	42963
	Average feed intake (g/hen/day)	106.32	111.07	115.18	122.9	126.1
	Eggs yield (pcs./group/period)	65118	64081	62895	194898	238479
	Feed conversion ratio (g feed/egg)	126.29	134.38	141.65	169.7	180.2
46-65 weeks (140 days)	Flock size (capitis)	411	416.5	415.5	1425.5	1836
	Feed intake (kg/group/period)	6444	6637	6728	25904	34238
	Average feed intake (g/hen/day)	111.99	113.82	115.66	129.8	133.2
	Eggs yield (pcs./group/period)	43993	43294	42480	132862	165137
	Feed conversion ratio (g feed/egg)	146.48	153.30	158.38	194.9	207.3
66-80 weeks (105 days)	Flock size (capitis)	394	405.5	407	1372	1782.5
	Feed intake (kg/group/period)	4954	5391	5795	17878	23826
	Average feed intake (g/hen/day)	119.74	126.61	135.60	124.1	127.3
	Eggs yield (pcs./group/period)	25897	25477	25005	79062	98941
	Feed conversion ratio (g feed/egg)	191.29	211.59	231.75	226.1	240.8
19-80 weeks (434 days)	Flock size (capitis)	408	415	416.5	1429	1820.5
	Feed intake (kg/group/period)	19622	20639	21432	76853	101027
	Average feed intake (g/hen/day)	**112.63**	**116.47**	**120.51**	**125.95**	**129.96**
	Eggs yield (pcs./group/period)	135008	132852	130380	407188	502557
	Feed conversion ratio (g feed/egg)	**145.34**	**155.35**	**164.38**	**188.74**	**201.03**