

The Influence of Different Part of Soybean in Mixture for Nutrition of One-Day Chick to 18 Weeks Age Chickens from Italian Breed in Individual Conditions

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Citation: Cilev, G., Pavlovski, Z., Radulovic, S., Stojanovski, S., Pacinovski, N., & Davidovski, Z. (2020). The Influence of Different Part of Soybean in Mixture for Nutrition of One-Day Chick to 18 Weeks Age Chickens from Italian Breed in Individual Conditions. *Zhivotnovadni Nauki*, 57(4), 38-47 (Bg).

Original scientific paper

Abstract

The aim of this experiment was examine the influence of different part of soybean in mixture for nutrition of one-day chick to 18 weeks age chickens from Italian breed in individual conditions in North Macedonia. The research was conducted in the individual conditions in village Stenche, near by the Tetovo, North Macedonia in 2018 year. The research was done on Italian breed chickens, kept the flooring system of two clusters of 40 chickens, 6 or 12 m² in the initial phase. When breeding chicks were used 2 or 4 bulbs of 200 W, 2 or 4 and 2 feeders and drinkers for both clusters. Despite light bulbs for a program it used to maintain the warmth of chicks (replacement for artificial brooder). The water was changed every 24 hours (1 day), the first 7 days in water was added after one teaspoon Zivamicyn and the food was consistently fresh and feeders were constantly maintained. The survey was conducted in the period from 06/04/2018–13/08/2018, of one group, while the second group the same survey was conducted in the period from 06/04/2018–03/09/2018, within the this time period studied two influences and first impact of 30% soybean intake and growth of chickens in individual conditions and the impact of the second 20% soybean in the diet of chickens in individual conditions. The average body weight (ABW) on the first day in chicks feed with 30% of soybean was 45.60 grams and in those feed 20% of soybean was 45.20 grams, which means the difference in weight between the two flocks 0.40 grams. The average weight of growth (AWG) on 30 days in chickens feed with 30% of soybean was 249.825 grams and in those feed 20% soybean was 173.175 grams, then the difference between the two flocks is 76.65 grams. Average of consumed food (ACF) per day in chickens feed with 30% soybean export 20 grams or within 30 days is 600 grams, while that of those feed 20% soybean was the same as in chickens from a flock of 30% soybean. The average weight of growth (AWG) on 31–60 day in chickens feed with 30% of soybean was 830.60 grams and in those feed 20% of soybean was 638.60 grams, then the difference between the two flocks is 192.00 grams. Average of consumed food (ACF) per day in chickens feed with 30% of soybean was 37.50 grams or for 30

days is 1125 grams and in those feed 20% soybean was the same as in chickens from a flock of 30% soybean. The average weight of growth (AWG) on 61–90 day in chickens feed with 30% of soybean was 1031.02 grams and in those feed 20% of soybean was 903.55 grams, then the difference between the two flocks is 127.47 grams. Average of consumed food (ACF) per day in chickens feed with 30% of soybean was 45.8 grams or for 30 days was 1374 grams and in those feed 20% soybean was the same as in chickens from a flock of 30% soybean. The average weight of growth (AWG) on 91–126 days (18 weeks) in chickens feed with 30% of soybean was 1403.50 grams, than average weight of growth (AWG) on 91–148 days (22 weeks) in those feed 20% of soybean amounted 1413.27 grams. The average consumed food (ACF) per day in chickens feed with 30% of soybeans was 48.6 grams or for a period of 36 days 91–126 days (18 weeks) was 1800 grams and in those feed 20% of soybean was 45.20 grams or for a period of 57 days 91–148 days (22 weeks) was 2850 grams. Average of consumed food (ACF) in chicken for the entire period in chickens feed with 30% soybean was 4900 grams and in those feed 20% soybean was 5950 grams, mean difference in diet between the two flocks was 1050 grams, less in favor of group of chicks fed with 30% of soybean. As a general conclusion from the research pushed fact that chicks feed 30% of soybean over the period of one day chicken 18 weeks of age, i.e. laying hens (bright piece) achieved nearly identical weight as chicks feed 20% soybean (up to 22 weeks of age), but for a shorter period of 28 days (4 weeks) and lower consumption of food for about 1050 grams or achieve better conversion and a speedier laying eggs.

Key words: one-day chicks, chickens, Italian breed, soybean, nutrition, individual conditions

Introduction

Year by year, the number of the world's population is growing. Energy and food resources, each year more and more reduced. Alternative solutions are constantly seeking and never satisfied. Animal technology day trying to feed the world and seek solutions through cleverly genetically modified organisms, clones and other biotechnological advances. In any case, it should not turn its back on nature and not to forget that alternatives it offers and what resources, with a small processing, may have high values. A poultry breeding poultry (home birds), is present on all continents. Since most poultry reared chickens, turkeys, geese, ducks, guinea fowl, ostriches and more. They are receiving eggs, meat and feathers. In all countries chickens are raised in modern poultry farms (Sencic, 1994). According to the number, most poultry is grown in China, Russia and the United States. Macedonia is also not behind these countries. Poultry is an important livestock industry in Macedonia. In 2000 year the country had a total of 3.173.369 units and now in 2014 year the number decrease and had of 1.939.879 units.

Birds (Aves) is bipedal warm-blooded animals are the main features for the body feathers, forelimbs modified as wings, and hollow bones (legs). Birds come in different sizes: from tiny hummingbirds to huge emua, ostriches, laying hens, guinea fowl, turkeys, ducks, geese and many others (Kralj, 1995). From a taxonomic point of view, there are about 8.800 to 10.200 species of living birds, and about 120 to 130 that are already extinct in the world, making them the most widespread class of terrestrial vertebrates. Characteristic signs of birds bony beak with no teeth, laying and incubation of solid limestone eggs, high metabolic rate and lightweight but strong skeleton. Most birds fly, although some of them racing birds and several other species that live mostly on the islands have lost this ability (Petrovic, 1991). Non-flying birds at risk of extinction if people or other mammals settle in their habitat or habitat. For example, pamoate of New Zealand's extinct due to human impact. Poultry is among the most-studied animal groups (Kralik, 2008). Hundreds of academic journals thousands of scientists dedicated to the study of birds, while the number of amateur enthusiasts (Flushing) and climbs to millions. The main pur-

pose of this paper is the research part consists of analyzing the impact of different ratios of soy blend for feeding the growth of day-old chicks to 18 weeks of age in chickens of Italian breed in individual conditions.

Material and Methods

The research was conducted in the individual conditions in village Stenche, near by the Tetovo, North Macedonia in 2018 year. The research was done on Italian race, kept the flooring system of two clusters of 40 chickens, 6 or 12 m² in the initial phase. When breeding chicks were used 2 or 4 bulbs of 200 W, 2 or 4 and 2 feeders and drinkers for both clusters. Despite light bulbs for a program it used to maintain the warmth of chicks (replacement for artificial brooder). The water was changed every 24 hours (1 day), the first 7 days in water was added after one teaspoon Zivamicyn and the food was consistently fresh and feeders were constantly maintained. Determination of crude protein in animal feed was done with Official Method of Analysis-Analytical Method (AOAC, 2001).

The survey was conducted in the period from 06/04/2018–13/08/2018, of one group, while the second group the same survey was conducted in the period from 06/04/2018–03/09/2018, within

Table 1. Food for chicks in first 30 days (40 chicks)

Day	Food	Water
1–12	6 kg	1l/24h
13–15	3 kg	1l/24h
16–18	3 kg	1l/24h
19–21	3 kg	1l/24h
22–24	3 kg	1l/24h
25–27	3 kg	1l/24h
28–30	3 kg	1l/24h
Total Amount	24 kg	/
Average consumed food/ Chick for 30 days	0.600 kg (600 grams)	/
Average consumed food/ On chick per day	0.020 kg (20 grams)	/

the this time period studied two influences and first impact of 30% soybean intake and growth of chickens in individual conditions and the impact of the second 20% soybean in the diet of chickens in individual conditions.

Table 2. Food for chicks in period of 31–60 day (40 chicks)

Day	Food	Water
31–34	6 kg	1.5 l/24h
35–38	6 kg	1.5 l/24h
39–42	6 kg	1.5 l/24h
43–46	6 kg	1.5 l/24h
47–50	6 kg	1.5 l/24h
51–54	6 kg	1.5 l/24h
55–58	6 kg	1.5 l/24h
59–60	3 kg	1.5 l/24h
Total Amount	45 kg	/
Average consumed food/ Chick for 30 days	1.125 kg (1125 grams)	/
Average consumed food/ On chick per day	0.0375 kg (37.5 grams)	/

Table 3. Food for chicks in period of 61–90 day (40 chicks)

Day	Food	Water
61–63	5 kg	1.5 l/24h
64–66	5 kg	1.5 l/24h
67–69	5 kg	2 l/24h
70 – 72	5 kg	2 l/24h
73–75	5 kg	2 l/24h
76–78	6 kg	2 l/24h
79–81	6 kg	2 l/24h
82–84	6 kg	2 l/24h
85–87	6 kg	2 l/24h
88–90	6 kg	2 l/24h
Total Amount	55 kg	/
Average consumed food/ Chick for 30 days	1.375 kg (1375 grams)	/
Average consumed food/ On chick per day	0.0458 kg (45.8 grams)	/

The first 12 days are used 6 kg of food, from 13–30 days, every 3 days is put on 3 kg of food. The amount of food is using 40 chicks over 30 days is 24 kg or an average of 600 grams per day or a 20 grams per chick on day.

Over a period of 31–60 days for feeding chicks spent a total of 45 kg of food, which is added every 4 days, only in the final period of 59–60 days were added 3 kg of food. On average 1.125 kg per day for 40 chicks or 37.5 grams on chick per day.

Over a period of 61–75 days were used in 5 kg of food every 3 days, 75–90 days are used 6 kg of food every 3 days for 40 chicks, spent a total of 55 kg of food, or approximately average 1.375 kg of food per day for 40 chicks or 45.8 grams average per chick daily.

For a period of 91–126 days total consumed amount of feed of 72 kg, in average 1.8 kg on day 40 chicks or 51.4 grams per day chick supplements have entered where 30% of soybean. Second flock of chicks which have a diet with 20%

Table 4. Food for chicks in period of 91 day to laying (18 weeks for 30% soybean and 22 weeks for 20% soybean)

<i>Food for chicks in period of 91–126 day</i> 30% Soybean			<i>Food for chicks in period of 91–148 day</i> 20% Soybean		
Day	Food	Water	Day	Food	Water
91–93	6 kg	3 l/24h	91–93	6 kg	3 l/24h
94–96	6 kg	3 l/24h	94–96	6 kg	3 l/24h
97–99	6 kg	3 l/24h	97–99	6 kg	3 l/24h
100–102	6 kg	3 l/24h	100–102	6 kg	3 l/24h
103–105	6 kg	3 l/24h	103–105	6 kg	3 l/24h
106–108	6 kg	3 l/24h	106–108	6 kg	3 l/24h
109–111	6 kg	3 l/24h	109–111	6 kg	3 l/24h
112–114	6 kg	3 l/24h	112–114	6 kg	3 l/24h
115–117	6 kg	3 l/24h	115–117	6 kg	3 l/24h
118–120	6 kg	3 l/24h	118–120	6 kg	3 l/24h
121–123	6 kg	3 l/24h	121–123	6 kg	3 l/24h
124–126	6 kg	3 l/24h	124–126	6 kg	3 l/24h
X	X	X	127–129	6 kg	3 l/24h
X	X	X	130–132	6 kg	3 l/24h
X	X	X	133–135	6 kg	3 l/24h
X	X	X	136–138	6 kg	3 l/24h
X	X	X	139–141	6 kg	3 l/24h
X	X	X	142–144	6 kg	3 l/24h
	X	X	146–148	6 kg	3 l/24h
Total Amount	72 kg	/	Total Amount	114 kg	/
Average consumed food/ Chick for 35 days	1.80kg (1800 grams)	/	Average consumed food/ Chick for 57 days	2.85 kg (2850 grams)	/
Average consumed food/ On chick per day	0.0514 kg (51.4 grams)	/	Average consumed food/ On chick per day	0.0452 kg (45.2 grams)	/

soybean have consumed 114 kg feed, for a period of 91–148 days, an average of 2.85 kg of food per day or 45.2 grams on day per chick.

Considering that soybean plays a major role in the nutrition and growth of the poultry, this type of research was conducted on two groups of chicks from 40 individuals. The task was to see a simpler feeding chickens or by adding

Table 5. Total amount of consumed food in all period of chicks nutrition

Period in Days	Amount of consumed food with 30% soybean	Amount of consumed food with 20% soybean
1–30	24 kg	24 kg
31–60	45 kg	45 kg
61–90	55 kg	55 kg
91–126	72 kg	X
91–148	X	114 kg
TOTAL	196 kg	238 kg
Average per chicks in all period	4.90 kg	5.95 kg

Table 6. Body weight of day-old chicks (40 units)

Chicks (Italian breed)-40 units	
Borned	06/04/2018 year
Taked	07/04/2018 year
With body weight	40–55 grams
Average body weight	45.7 grams

Table 7. Feed mixture for chicks nutrition

Feedstufs	30% Soybean	20 % Soybean
Corn	40%	45%
Barley	7%	8%
Wheat	12%	15%
Soybean	30 %	20 %
Fish meal	4%	4%
Sunflower meal	4%	5%
Premix (protamino avant – sano)	3%	3%



Picture 1. Breeding chicks of Italian breed in individual conditions

larger amounts of soybean will achieve the corresponding results as well as in industrial consumption. Both groups were fed and reared on the same principle: the same amount of food, the same ventilation and heat in the building, light the same program, the same power and the same premises. The first group in their diet received 30% soybean (30 kg soybean on 100 kg food), then the second group received 20% of the soybean (20 kg soybean on 100 kg food).

Composition of premixes protamino avant (sano): Soybean meal, calcium, sodium phosphate, potassium carbonate, sodium chloride, DL-methionine, L-lysine monohydrochloride, choline chloride, premix of trace elements, vitamins and premix of active substances.

Results and Discussion

Poultry has a strategic importance for development of economy of the North Macedonia (Nikolova and Kocevski, 2006). This is one of the reasons that topics related to food and agricultural products, including eggs and meat of poultry, are becoming more current. Eggs is subtle matter of which affected the safety and security of health. Poultry industry as an integral part in the country plays an important role in the development of the overall economy of the country and in the trade with the world. It's important livestock industry in every world economy (Pav-

lovski, 2012). Eggs and meat products from poultry are also an important part of the daily diet of the population, and are therefore considered as an important priority of the strategic importance of each state is actually the development of this sector. Given the development of the poultry industry should be given primary importance as they could to meet the growing needs of customers as quantity and quality, and in product range not only domestic but also foreign markets.

Despite our country's dependence on imports of eggs and poultry meat products, there are many challenges and opportunities for the promotion of the Macedonian poultry sector relating to promotion of domestic production and processing. Eggs are one of the most important poultry products because they have great nutritional value that is essential for daily human consumption. Because of these beneficial properties of our markets is increasing demand for eggs and poultry meat products. Poultry farms, increasingly conscious of the needs of consumers as quantity and quality, and in product range. Supply to the market of eggs and meat products from poultry in the country constitutes domestic production composed of chickens, turkeys, ducks, geese and many other types of poultry.

In this paper topic of research will be the introduction of soybean in the diet of Italian breed without the addition of other additives, such as is the case in industrial farming, or "certain" poultry farms. Trials were carried out to provide a clear picture of the growth of day-old chicks to 18 weekly pullets and their conveying. In tables shown the unit weight of chickens over the period considered, the total weight of the total number of flocks, the average weight of clusters individually fed 20 and 30% of soybean and the difference between them.

Chemical composition of mixture

The chemical composition of the chick feeding used in the experiment is shown in Table 8. It is noted from the table that mixture with 30% of soybean have a 20.24% of protein, but the mixture with 20% of soybean have a 17.66% of protein, while the content of energy (3141.9 and 3114.8 ME Kcal/kg) is relatively uniform.

Table 8. Chemical composition of mixture for chick feeding, (%)

Chemical composition	Soybean	
	30%	20%
Moisture	11.69	11.90
Ash	4.78	4.49
Protein	20.24	17.66
Fat	7.95	6.39
Fibre	4.25	4.16
NEM	49.73	53.78
Calcium	0.33	0.31
Phosphorus	0.52	0.50
ME, Kcal/kg	3141.90	3114.80
Lysine	0.98	0.80
Metionin+cistin	0.58	0.53
Treonin	0.68	0.59
Leucin	1.57	1.42

Health condition

The chickens of all experimental groups in both trials were consistent body material, properly developed bone and muscle tissue, lively temperament and good fitness. Feathers, skin and visible mucous membranes were unparallel. The appetite was good, and feces was usually formed. The ability to actively move and coordinate the movements were aligned and the muscular tone was normally expressed. During the experiment there was no disturbance of the health condition and the manifestation of clinical signs of the disease or death.

Productive results

At the beginning of the experiment, the chicks of the two experimental groups were of uniform body weight, and there were no statistically significant differences between the groups (Table 9). In the middle of the experiment, the chickens of the experimental groups (20% of the soybean) had a slightly lower body mass. At the end of the experiment, the chickens of two experimental groups achieved approximately equal body

Table 9. Body weight of chickens in the trials, (g)

Group	n	Mesures of variation					
		X	±	Sx	Sd	Cv	Iv
		1 day					
Soybean 30%		45.6		0.68	4.31	9.43	39–55
Soybean 20%		45.2		0.64	4.03	8.90	38–55
		30 day					
Soybean 30%		249.8		0.85	5.37	2.15	240–261
Soybean 20%		173.2		1.02	6.42	3.70	162–185
		60 day					
Soybean 30%		830.6		1.30	8.23	0.99	810–843
Soybean 20%		638.6		1.35	8.53	1.33	621–655
		90 day					
Soybean 30%		1031.1		2.83	17.90	1.74	994–1075
Soybean 20%		903.5		5.98	37.81	4.18	849–995
		<u>126 day (18 weeks)</u>					
Soybean 30%		1403.5		5.57	35.19	2.51	1310–1460
		<u>148 day (22 weeks)</u>					
Soybean 20%		1413.2		5.37	33.95	2.40	1350–1492

$P > 0.05$

weight, with group chickens (30% of the soybean) achieving this in 126 days (18 weeks) while group chicks (20% of soybean) achieved this in 148 days (22 weeks). Differences between groups were not statistically significant ($p > 0.05$).

The average daily increasment of the chicks of individual experimental groups differed between the groups and in relation to the viewing phase (Table 10). The highest daily gain during the experiment was achieved by a group of chickens with 30% soybean, and the lowest group of chickens with 20% of soybean, with differences being statistically significant ($p < 0.05$). At the end of the experiment, the chickens of two experimental groups achieved approximately equal increase, with group chickens (30% of the soybean) achieving this in 126 days (18 weeks) while group chicks (20% of soybean) achieved this in 148 days (22 weeks). Differences between groups were not statistically significant ($p > 0.05$).

The average daily food consumption in both trials is shown in Table 11. Group of chickens with 30% soybean achieved food consumption typical of production conditions and almost

identical consumption of food was achieved by group chickens with 20% soybean. An increase in food consumption in a group of chickens with 20% soybean is saturated after 90 days and lasts up to 148 days.

Food conversion, as an interaction of food growth and consumption, varied between groups both in terms of the phase of the experiment and between the experiments (Table 12). Group of chickens with 30% soybean achieved food conversion typical of production conditions and almost identical conversion of food was achieved by group chickens with 20% soybean.

Our results compared with the results of the research of some authors (Dmello, 2000), Bestman et al. (2010), Kralik (2008), Kralik et al. (2008) show that they are within the limits of the literary data, which gives us the right to conclude that they will contribute to shortening the period of transmission in chickens, and thus saving in the protein component (soybean) in fodder mixtures which is of great economic importance for poultry production in individual conditions.

Table 10. Average increment of chickens during trials, (g/day)

Group	n	Measures of variation					
		X	±	Sx	Sd	Cv	Iv
		1–30 day					
Soybean 30%		204.2	^a	0.62	3.94	1.93	195–215
Soybean 20%		128.0	^b	1.11	7.00	5.48	113–144
		31–60 day					
Soybean 30%		508.8		0.93	5.85	1.00	563–594
Soybean 20%		465.4		1.52	9.58	2.05	442–486
		61–90 day					
Soybean 30%		200.5		2.56	16.20	8.08	163–235
Soybean 20%		264.9		6.51	41.14	15.53	211–373
		91–126 day					
Soybean 30%		372.4		5.85	37.01	9.94	279–447
		91–148 day					
Soybean 20%		509.7		8.04	50.79	9.96	420–627
		1–126 day					
Soybean 30%		1358		5.54	35.02	2.58	1267–1409
		1–148 day					
Soybean 20%		1368		5.48	34.61	2.53	1302–1444

^{a, b} $P < 0.05$

Conclusions

According implemented trials and the results, can make the following conclusions:

The average body weight (ABW) on the first day in chickens feed with 30% of soybean was 45.60 grams and in those feed 20% of soybean was 45.20 grams, which means the difference in weight between the two flocks 0.40 grams;

The average weight of growth (AWG) on 30 days in chickens feed with 30% of soybean was 249,825 grams and in those feed 20% soybean was 173.175 grams, then the difference between the two flocks is 76.65 grams;

Average of consumed food (ACF) per chicken per day in chickens feed with 30% soybean ex-

port 20 grams, or within 30 days is 600 grams, while that of those feed 20% soybean was the same as in chickens from a flock of 30% soybean;

The average weight of growth (AWG) on 31–60 day in chickens feed with 30% of soybean was 830.60 grams and in those feed 20% of soybean was 638.60 grams, then the difference between the two flocks is 192.00 grams;

Average of consumed food (ACF) per chicken per day in chickens feed with 30% of soybean was 37.50 grams or for 30 days is 1125 grams and in those feed 20% soybean was the same as in chickens from a flock of 30% soybean;

The average weight of growth (AWG) on 61–90 day in chickens feed with 30% of soybean was 1031.02 grams and in those feed 20% of soybean

was 903.55 grams, then the difference between the two flocks is 127.47 grams;

Average of consumed food (ACF) per chicken per day in chickens feed with 30% of soybean was 45.8 grams or for 30 days was 1374 grams and in those feed 20% soybean was the same as in chickens from a flock of 30% soybean;

The average weight of growth (AWG) on 91–126 days (18 weeks) in chickens feed with 30% of soybean was 1403.50 grams, than average weight growth of 91–148 days (22 weeks) in those feed 20% of soybean amounted 1413.27 grams;

The average food consumed (AFC) per chicken per day in chickens feed with 30% of soybean was 48.6 grams or for a period of 36 days 91–126 days (18 weeks) was 1800 grams and in those feed 20% of soybean was 45.20 grams or for a period of 57 days 91–148 days (22 weeks) was 2850 grams;

Average of consumed food in chicken for the entire period in chickens feed with 30% of soybean was 4900 grams and in those feed 20% soybean was 5950 grams, mean difference in diet between the two flocks was 1050 grams, less in favor of flock of chicks feed with 30% of soybean.

As a general conclusion from the research pushed fact that chicks feed 30% of soybeans over the period of one-day old to chicken 18 weeks of age, i.e. laying hens (bright piece) achieved nearly identical weight as chicks feed 20% soybean (up to 22 weeks of age), but for a shorter period of 28 days (4 weeks) and lower consumption of food for about 1050 grams or achieve better conversion of food and a speedier laying eggs.

References

- Динев, И., & CEVA Animal health Bulgaria LTD** (2006). Болести по птиците-Цветен атлас, CEVA Sante Animale
- Bestman, M., Ruis, M., Haijmens, J., & Mittelco von K.** (2010). Poultry signals – A practical guide for bird focused poultry farming. Rootbant Publishers.
- Bogut, I., Grbavac, J., & Florijančić, T.** (2001). Anatomija i fiziologija domaćih životinja. Mostar-Osijek.
- Cherry Vallery Farms** (1985). Cherry Vallery Super M Parent Stock Managemnet *Manual*. Rothwell, Lincoln. USA
- David, S.** (2004). Storey's Illustrated Guide to Poultry Breeds.
- D'Mello, J. F.** (Ed.). (2000). *Farm animal metabolism and nutrition*. Critical Reviews. Oxford University Press. Cabi.
- Garnsworth, C. P., & Wieseman, J.** (2009) Recent advances in animal nutrition. *Nottingham Book. University Press*
- Kozaric, Z** (2000). Veterinraska histologija. *Karolina, Zagreb*.
- Kralik, G., Has-Schön, E., Kralik, D., & Šperanda, M.** (2008). PERADARSTVO-Bioloski i zootehnicki principi. Poljoprivredni fakultet-Osijek
- Kralik, G., Gajčević, Z., & Škrčić, F.** (2008). The effect of different oil supplementations on laying performance and fatty acid composition of egg yolk. *Italian Journal of Animal Science*, 7(2), 173-183.
- Kralj, D.** (1991). Smjenrnice EU u peradarskoj proizvodnjih kafezi/alternativni nacini drzenja-primenja u pravci. *Stocarstvo* 59,189-201
- Leeson, S., & Summers, J. D.** (2005) Comercial poultry nutrition 3rd Ed. *Nottingham University Press*.
- Lukić, M., Pavlovski, Z., & Škrbić, Z.** (2009). Mineral nutrition of modern poultry genotypes. Institute for Animal Husbandry Belgrade-Zemun *Biotechnology in Animal Husbandry*, 25(5-6-1), 399-409.
- Miller, P. C., & Sunde, M. L.** (1975). The effect of various particle sizes of oyster shell and limestone on performance of laying leghorn pullets. *Poultry science*, 54(5), 1422-1433.
- Muzic, S.** (1995). Proizvodnje inkubacija kokosjih jaja, *Biblioteka Agrohita, Zagreb*.
- Muzic, S., & Dancevic, Z.** (2002). Peradarska proizvodnja u Hrvatskoj, Zagreb
- Nikolova, N., & Kočevski, D.** (2006). Forming egg shape index as influenced by ambient temperatures and age of hens. *Biotechnology in Animal Husbandry*, 22(1-2), 119-125.
- Nemanic, R., & Beric, J.** (1995). Peradarstvo. Nakladni zavod globus, Zagreb
- Pavlovski, Z., Škrbić, Z., Lukić, M., Vitorović, D., Lilić, S., & Petričević, V.** (2012). Shell quality: Everlasting problem in the today poultry science. Institute for Animal Husbandry Belgrade-Zemun. *Biotechnology in Animal Husbandry*, 28(3), 393-404.
- Pavlovski, Z., & Vitorović, D.** (1996). Direktna metoda za određivanje čvrstoće ljuske jaja. *Nauka u zivinarstvu*, 3-4, 171-175
- Pavlovski, Z., Vitorović, D., Škrbić, Z., & Vračar, S.** (2000). Influence of limestone particle size in diets for hens

and oviposition time on eggshell quality. *Acta veterinaria, Belgrade*, 50(1), 37-42.

Pavlovski, Z., Vitorović, D., Lukić, M., & Spasojević, I. (2003). Improving eggshell quality by replacement of pulverised limestone by granular limestone in the hen diet. *Acta veterinaria, Belgrade*, 53(1), 35-40.

Petrović V. (1991). *Zivinarstvo. Naucna knjiga*, Beograd

Sencic, G. (1994). *Peradarstvo. Gospodarski list*, Zagreb

Sevkovic, N., Pribicevic, S., & Rajic I. (1980). *Ishrana domacih zivotinje. Naucna knjiga*, Beograd

Supic, B., Milosevic, N., & Cobic T. (2000) *Zivinarstvo*, Novi Sad.

AOAC (2001). Official Method of Analysis-Analytical Method of Determination of Protein (Crude) in Animal Feed, 35th ed (Ed: Stolof. L) Washington. DC.

IRPP, B. (2003). Integrated Pollution Prevention and Control (IPPC). *Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs*.

ISA General Management Guide Commercials. (2009)

Hy-Line Brown Management Guide (2014).

Jet Masster Manual. (2000). Big Dutchman International GmbH

NRC-National Research Council (1994). Nutrient requirement of poultry – 9th revised edition, *National Academy Press*, Washington, D. C.