

Evaluation of the ostrich carcass reared and slaughtered in Macedonia

Naseva Dijana¹, Pejkovski Zlatko², Lilić Slobodan³

Abstract: The examinations were conducted on 12 ostriches of Black-Neck African breed, reared in Macedonia and slaughtered at the age of 12 to 14 months. Following items were examined: live weight, slaughtered weight, weight of by-products, dressing percentage, loss of weight after chilling, some linear measurements of the carcass, mass of the basic parts of the carcass and the content of meat and bones in the basic parts of the carcass. It was established that the average live weight of ostriches was 103.72 kg, slaughtered weight 51.33 kg and dressing percentage 49.49%. The participation of separate by-products in live weight of ostrich was: head 0.70%, skin 8.19%, legs 3.93%, liver 1.48%, lungs 0.57%, heart 0.97%, full gizzard 8.46%, empty gizzard 4.39%, full intestines 10.96%, oesophagus and trachea 0.46% and abdominal fat 4.23%.

Carcass length (clavicula - os pubis) was 74.92 cm and thigh length (os pubis - tibia-tarsus ankle) 76.92 cm, circumference of thigh 62.83 cm and the length of the neck was 81.33 cm. Carcass length (clavicula - os pubis) was 74.92 cm and thigh length (os pubis - tibia-tarsus ankle) 76.92 cm, circumference of thigh 62.83 cm and the length of the neck was 81.33 cm. In the slaughtered weight thighs participated with 31.19%, back 49.78%, breasts 15.04% and neck 3.99%. The thighs contained 24.12% meat and 7.05% bones from the slaughtered weight, back contained 41.63% meat and 8.14% bones, breasts 4.75% meat and 10.29% bones. The thigh contained 77.39% meat and 22.61% bone, back - 83.64% meat and 16.36% bones and breasts 31.61% meat and 68.39% bones. Ostrich carcass contained 70.50% meat and 25.48% bones (without meat and bones from the neck).

Key words: ostrich, dressing percentage, by-products.

Introduction

Ostrich (*Struthio camelus*, L.) is the largest and heaviest bird in the world and lays the largest eggs in comparison with the other birds. Its height is more than 2.7 m, and the weight can exceed 150 kg (Cramp *et al.*, 1977). Considering the rudimentary shape of its wings and feathers, the ostrich cannot fly, although its ancestors were capable of flying. Regarding the fact that ostriches cannot fly, they spend their life in walking and running when threatened, and therefore they can achieve speed of 60-70 km/h (Cramp *et al.*, 1977; Alexander *et al.*, 1979).

The ostrich production in the Republic of Macedonia is not sufficiently developed and there are no researches interested in this topic. In the countries with developed ostrich production (South Africa, USA, Canada, Israel, Australia, China, France), greater attention is paid to this branch of animal husbandry, but the maximal experience in rearing of these birds is not reached yet. At the XII World Ostrich

Congress, held in October 2005 in Madrid, an average estimation of the number of ostriches reared in the countries of the world is made. According to the rough estimation, 350 000 birds were slaughtered in 2005. South Africa dominates with 43% i.e. 150 000 birds that were slaughtered, the next is China with 50 000, Zimbabwe with 20 000, Brazil, USA and Israel with 10 000 birds, Hungary with 8 000, Spain with 7 000, Philippines with 5 000 (Carbajo, 2006).

Obtaining ostrich meat is of great importance. Here, as in the other branches of the industry, the quality of the final product has influence over the effectiveness of the production and the quality of products. Therefore, effective methods should be used in the processing of ostrich meat (Dragoev, 2004).

Considering that rearing of ostriches is a new animal husbandry branch in the Republic of Macedonia, researches about ostriches have not been performed yet, and within world frameworks the yield and quality of ostrich meat have not been stu-

¹"Goce Delcev" University - Stip, Faculty of Agriculture, Street Krste Misirkov bb, 2000 Stip, Macedonia;

²"St Cyril and Methodius" University - Skopje, Faculty of agricultural sciences and food - Skopje, Boulevard Aleksandar Makedonski bb, 1000 Skopje, Macedonia;

³Institute of Meat Hygiene and Technology, Kačanskog 13, 11 000 Belgrade, Republic of Serbia.

died so far. Therefore, the aim of this paper was to examine:

- Live weight, carcass yield, weight of by-products, dressing percentage and weight loss after chilling,
- Share of some parts and organs in the live weight and carcass,
- Linear measurements of carcass;
- Share of meat and bones in some parts and whole carcass.

Material and methods

The experimental examinations were performed on twelve ostriches (African Black Neck ostrich) reared on the farms of the Republic of Macedonia.

The age of ostriches was between 12-14 months. This is generally accepted age for slaughtering of this race, as a period when the best meat is obtained in regard to the quality and quantity. The ostriches were fed with feed mixture, that regarding the previous experience of those who reared ostriches in the Republic of Macedonia, has proven to be the best one. The composition of the mixture was 40% alfalfa, 60% cereals (maize, barley, soya, sunflower meal and bran) salt, chalk and vitamins.

Ostriches received minimal amount of food and water 24 hours before slaughtering.

The slaughtering and primary processing of ostriches were performed on adapted slaughtering line for ostriches in slaughterhouse with cold storage "Zi-Va" Joint Stock Company Stip, the unique slaughterhouse in Macedonia that has certificate for slaughtering of ostriches. Firstly, measuring of the live weight of ostriches was performed. Ostriches were stunned by blow to the head using a hard object. Afterwards, the birds were hanged on hanging conveyor and slaughtered by removing their heads. Feathers were manually removed and collected in paper bags; legs were removed at the point of tibio-tarsal joint and skin was removed as well. Evisceration was performed in hanging position of the bird. Carcass, feather, skin, liver, heart, emptied stomach, full intestines, lung, throat, wind pipe and suet were measured by digital scale.

Carcasses were chilled at the temperature 0-1°C for 24 hours, and measured after chilling. The loss of weight after chilling was calculated as difference between pre slaughter and post slaughter weights.

The dressing percentage was calculated as a ratio between slaughter and live weight of ostriches. Based on the ratio of live and slaughter weight of ostriches before and after chilling of carcasses, the following parameters were calculated: dressing percen-

tage of warm carcass without head and internal organs and dressing percentage of chilled carcass without head and internal organs.

Carcasses were cut into two halves/sides and the following linear measurements were taken on the right halves:

- Length of carcass: from collar-bone (clavicle) to pubis (*os pubis*) from the internal part of the half;
- Length of thigh: from pubis (*os pubis*) to tibial-tarsal joint;
- Thigh size in the thickest part;
- Length of neck: from atlas to the last cervical vertebra.

Weights of main parts (thigh, back and thorax) were measured after cutting.

Results and discussion

Live weight, carcass weight (after evisceration and chilling), dressing percentage (warm and chilled) and weight losses after chilling are shown in Table 1. Average live weight of black-neck ostrich (103.72 kg) reared in Macedonia was higher than live weight of ostriches reared in Texas, Louisiana, Oklahoma and Indiana that had average 95.54 kg (Morris *et al.*, 1995). The average was obtained for 14 ostriches in the age from 10 to 14 months. Average weight of 25 ostricha which were examined by Pollok *et al.*, (1997) reared in Texas, was 99.73 kg in the age of 10 to 14 months. According to Kreibich and Sommer (1994), live weight of ostriches at the age of 14 months was 105 to 125 kg.

Slaughter weight before chilling was 52.93 kg and after chilling 51.33 kg. Examinations of Morris *et al.* (1995) showed slaughter weight of warm carcass of 55.91 kg, and of chilled carcass 54.57 kg, which is higher than this result, and according to Pollok *et al.* (1997), lower results were obtained, i.e. the weight of carcasses before chilling of 48.82 kg, and the weight of chilled carcass of 47.55 kg. Loss of weight after chilling in these examinations was 1.59 kg or 3.04% which is by 0.25 kg higher than the loss of weight after chilling reported in the results of Morris *et al.* (1995) and 0.32 kg higher than loss of weight under chilling reported by Pollok *et al.* (1997).

Dressing percentage of ostriches, established in these examinations was 51.03% of warm carcass, i.e. 49.39% of chilled carcass. These values are close to those (51%) established by Balog and Almeida (2007) and Pollok *et al.* (1997), and slightly higher than the findings (58.6%) of Morris *et al.* (1995).

Table 1. Live weight, slaughter weight, carcass yield and losses of weight after chilling
Tabela 1. Telesna masa, masa nakon klanja randman i kalo/gubitak mase nakon hlađenja

Examined parameters/Ispitivani parametri	X	Sd	Cv
Live weight/Telesna masa, kg	103.72	9.22	8.89
Slaughter weight/ Masa nakon klanja, kg	52.93	6.01	11.36
Slaughter weight chilled/Masa ohlađenog trupa, kg	51.33	5.93	11.56
Losses of weight after chilling/ Gubitak mase nakon hlađenja	kg	1.59	18.41
	%	3.04	17.99
Dressing percentage of warm carcass/ Randman toplog trupa %	51.03	3.05	5.98
Dressing percentage of chilled carcass/ Randman ohlađenog trupa %	49.49	2.99	6.07

The differences in dressing percentage are the result of the age and nutrition of ostriches and of the period of starving before slaughtering as well.

Appropriate values were obtained for the weight of accompanying products, which are shown in the table 2 (expressed in kilos) and table 3 (in%).

Table 2. Accompanying products of ostriches in kg
Tabela 2. Prateći/sekundarni proizvodi nojeva u kg

Examined parameters/Ispitivani parametri	X	Sd	Cv
Feathers/Perje*	5.93	1.36	22.85
Head/Glava	0.72	0.13	17.70
Skin/Koža	8.51	1.46	17.19
Legs/Noge	4.06	0.29	7.27
Liver/Jetra	1.53	0.19	11.66
Heart/Srce	1.01	0.12	12.21
Full stomach/Pun stomak	8.77	1.05	11.94
Empty stomach/Prazan stomak	4.55	0.59	13.16
Full intestines/Puna creva	11.32	1.0796	9.536
Lung/Pluća	0.58	0.07	12.104
Oesophagus + wind pipe/Jednjak i traheja	0.47	0.075	15.87
Suet/Salo, mast	4.43	2.33	52.57
Other/Ostalo	3.46	0.34	9.73

* Feathers + cloacae + end parts of the wings/Perje + kloaka + krajevi krila

Table 3. Shares of accompanying products in the live-weight of ostriches, in%
Tabela 3. Udeli pratećih proizvoda u telesnoj masi nojeva,%

Examined parameters/Ispitivani parametri	X	Sd	Cv
Feathers/Perje*	5.72	1.37	23.95
Head/Glava	0.69	0.09	13.14
Skin/Koža	8.20	1.16	14.16
Legs/Noge	3.91	0.39	9.81
Liver/Jetra	1.48	0.19	12.92
Heart/Srce	0.97	0.12	11.02
Full stomach/Pun stomak	8.46	0.66	7.75
Empty stomach/Prazan stomak	4.39	0.39	9.07
Full intestines/Puna creva	10.91	1.106	10.09
Lung/Pluća	0.56	0.09	16.02
Oesophagus + wind pipe/Jednjak i traheja	0.45	0.06	13.64
Suet/Salo, mast	4.27	1.99	47.15
Other/Ostalo	3.34	0.29	8.65

* Feathers + cloacae + end parts of the wings/Perje + kloaka + krajevi krila.

With quantitative estimation, the following points were established: the ostriches' carcass and the weight of accompanying products (feathers, head, skin, legs, liver, heart, full and empty stomach, full intestines, lung, esophagus + wind pipe, suet etc.) Data concerning the weighing of accompanying products show that the average weight of feathers was 5.93 kg (5.72%), the skin - 8.51 kg (8.20%), and the legs cut in the tarsometatarsal joint - 4.06 kg (3.91%). The weight of the head in these researches was 0.72 kg (0.69%). The values obtained for the weight of ostrich heads were very close to those obtained by *Morris et al.*, (1995) – 0.78 kg, i.e. 0.68%, *Pollok et al.*, (1997) – 0.68 kg, i.e. 0.7%. The full stomach in these researches had weight of 8.77 kg, and the empty one of 4.55 kg. The share of full stomach in the live weight was 8.46%, and of the empty one 4.39%. *Morris et al.* (1995) obtained lower values – 5.8 kg, i.e. 6.05%, and the lowest values were obtained by *Pollok et al.* (1997) – 3.14 kg, i.e. 3.1%. According to this research, the weight of full intestines was 11.32 kg or 10.91% which was higher in comparison with the results of *Morris et al.* (1995) – 8.29 kg, i.e. 8.68% and lower in comparison with the results of *Pollok et al.* (1997) – 14.41 kg, i.e. 14.7%. The internal organs that were weighed in this experiment were following: heart, liver, lungs. 1.01 kg or 0.97% was the weight of the heart obtained in this research. According to *Kreibich and Sommer*, (1994) the weight of the heart was 600–700 g, which was by 300–400 g less. According to *Morris et al.* (1995) – 0.94 kg, i.e. 0.99% and according to *Pollok et al.*, (1997) – 0.91 kg, i.e. 0.9% those results were very close to those obtained in this master thesis. The average weight of the liver was 1.53kg or 1.48%. In comparison to the results of *Morris et al.*, (1995) - 1.42kg or 1.49% no great difference could be established, and compared to the results of *Pollok et al.*, (1997) – 1.77 kg, i.e. 1.7% there was a difference of 0.24 kg, i.e. 0.22%, so the liver was heavier compared to this research. The weight of the suet was 4.43 kg or 4.27% which was almost identical in comparison with the results of *Morris et al.*, (1995) – 4.11 kg, i.e. 4.28% and lower in comparison with the results of *Pollok et al.*, (1997) – 5.55 kg, i.e. 5.5%

The average values of the linear measurements were following:

- Average length of the carcass, measured from the internal part of the half, from the last cervical vertebra to the pubis (*os pubis*) amounts 74.92 cm.
- The average length of thigh from pubis (*os pubis*) to tibial-tarsal joint amounts 76.92 cm.
- Thigh size, measured in the thickest part, amounts 62.83 cm in average.
- The neck length, measured from the first to the last cervical vertebra amounts 81.33 cm in average.

The average of the main parts of the carcass is shown in the table 4.

From one ostrich, in average, 70.50% meat and 25.48% bones can be obtained, and therefore the percentage is expressed as proportion of the chilled carcass weight, because the bones were removed 24 hours after chilling. In comparison with the results of *Harris et al.*, (1994), where 64.5% lean meat and 26.9% bones were obtained, we can conclude that in this experiment by 6% more meat and 1.42% less bones were obtained.

The average meat yield of ostriches in Macedonia was 36.20 kg meat or 34.90% of the live weight, which is almost identical to the result of *Harris et al.*, (1994), where 35.7% of lean meat was obtained regarding the live weight. *Cooper* (2001) obtained that meat yield of ostriches was 35 kg of lean meat, which is by 1.2 kg less than the results obtained in this master thesis. The neck weight in this thesis was 2.05 kg or 3.99% which was not very different from the results of *Harris et al.*, (1994), where the share of the neck was 4.33%. The back had the highest meat yield 25.55 kg, i.e. 49.78%. The meat from the back is the softest and the best for consumption, but it contains greater amount of fats in comparison to the thigh meat (16.01 kg, i.e. 31.19%), which is tougher and it is mostly used for production of meat products. Thorax (7.72 kg i.e. 15.04%) contained less meat as a result of the absence of pectoral muscles and the inability to fly.

The content of meat and bones in the main parts of ostriches' carcass is shown in table 5.

Table 4. Main carcass parts of ostriche, in kg

Tabela 4. Osnovni delovi trupa nojeva, kg

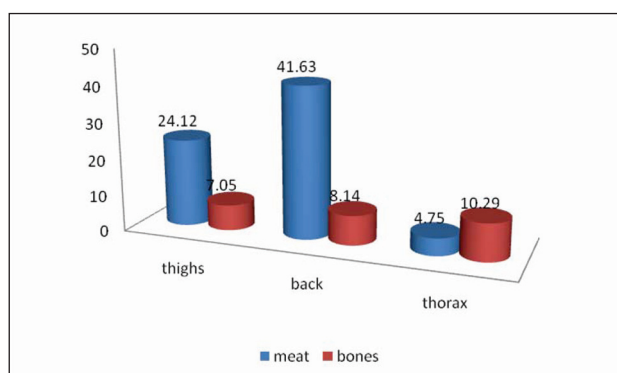
Examined parameters/Ispitivani parametri	X	Sd	Cv
Slaughter weight of chilled carcass/ Masa ohladenog trupa, kg	51.33	5.93	11.56
Neck/Vrat	2.05	0.36	17.48
Thighs/Bataci	16.01	1.88	17.48
Back/Leda	25.55	3.67	14.22
Thorax/Grudi	7.72	0.83	10.43

Table 5. Content/shane of meat and bones in the main carcass parts of ostriches, in kg
Tabela 5. Sadržaj/udeo mesa i kostiju u osnovnim delovima trupa nojeva, kg

Examined parameters/Ispitivani parametri		X	Sd	Cv
Slaughter weight of chilled carcass/ Masa ohlađenog trupa		51.33	5.93	11.56
Thighs/Bataci	Meat/Meso	12.39	0.896	14.49
	Bones/Kosti	3.62	0.23	12.66
Back/Leda	Meat/Meso	21.37	3.233	15.12
	Bones/Kosti	4.18	0.567	13.57
Thorax/Grudi	Meat/Meso	2.44	0.318	13.07
	Bones/Kosti	5.28	0.54	10.14

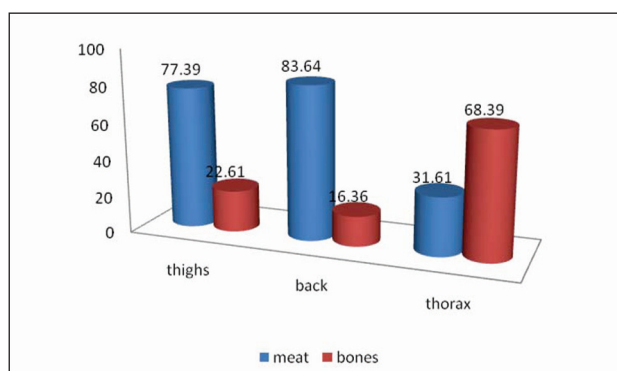
The share of meat and bones in the slaughter weight is graphically shown in chart 1.

The best meat bone ratio was established in the back (83.64% versus 16.36%), followed by thigh (77.33% versus 22.61%), thorax contained more bones than meat (68.39% bones, 31.61% meat). These ratios are graphically shown in the chart 2.



Graph 1. Participation of main carcass parts in the slaughter weight of ostriches, in%

Grafikon 1. Udeli osnovnih delova trupa u masi nakon klanja, %



Graph 2. Participation of meat and bones in the main carcass parts of ostriches, in%

Grafikon 2. Udeo mesa i kostiju u osnovnim delovima trupa, %

Conclusion

On the basis of the results obtained from the quantitative estimation of carcass, i.e. the slaughter weight of ostriches (live weight, slaughter weight, dressing percentage, loss of weight under chilling, yield of secondary products, weight and tissue composition of the main parts of carcass), the following conclusions can be made:

1. The average live weight of ostriches from the African Black-Neck ostrich breed, slaughtered in the age of 12-14 months, was 103.72 kg. The slaughter weight of warm carcass was 52.93 kg, and of chilled one 51.33 kg. The loss of weight under chilling was 3.04%, and dressing percentage of warm carcass was 51.03% and of chilled carcass 49.49%.

2. The weights of secondary products of ostriches were following: feathers, together with cloacae and end parts of wings 5.93 kg, skin 8.51 kg, head 0.72 kg, legs 4.06 kg, liver 1.53 kg, heart 1.01 kg, full stomach 8.77 kg, empty stomach 4.55 kg, full intestines 11.32 kg, lung 0.58 kg, oesophagus with wind-pipe 0.47 kg and suet 4.43 kg. The weights of secondary products, expressed as the percentage of the live-weight, were following: feathers with cloacae and end parts of the wings 5.72%, skin 8.20%, head 0.69%, legs 3.91%, liver 1.48%, heart 0.97%, full stomach 8.46%, empty stomach 4.39%, full intestines 10.91%, lung 0.56%, esophagus with wind-pipe 0.45% and suet 4.27%.

3. The length of carcass was 74.92 cm, the neck - 81.33 cm, the thigh - 76.92 cm and the thigh size was 62.83 cm.

4. The weight of the neck was 2.05 kg, the thighs weighed 16.01 kg, the back - 25.55 kg and the thorax - 7.72 kg. Their shares expressed as the percentage in the slaughter weight of chilled carcass were: neck 3.99, thighs 31.19, back 49.78 and thorax 15.04%.

5. The carcass of ostrich contained 70.50% meat and 25.48% bones. The thigh contained 77.39% meat and 22.61% bones, the back contained 83.64%

meat and 16.36% bones, the thorax contained 31.61% meat and 68.39% bones.

6. The muscle tissue of the ostrich thigh contained: water 74.52%, albumen 22.62%, fats 0.34%, and minerals 1.22%. The meat from the thigh of

broilers contains: 75.58% water, 17.57% albumen, 5.2% fats and 0.91% minerals. The beef meat (*m. longissimus dorsi*) contains: water 74.21%, albumen 21.22%, fats 1.89% and minerals 1.09%.

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Ocena trupova nojeva proizvedenih u Makedoniji

Naseva Dijana, Pejkovski Zlatko, Lilić Slobodan

Rezime: Ispitivanja su izvedena na 12 crnovrnatih afričkih nojeva koji su odgajeni u Makedoniji, zaklanih u uzrastu od 12 do 14 meseci. Ispitivani su sledeći parametri: telesna masa, masa nakon klanja, masa sporednih proizvoda, prinos trupova, gubitak mase posle hlađenja, neke linearne mere trupa, masa osnovnih delova i udeo mesa i kostiju u osnovnim delovima trupa. Prosečna telesna masa nojeva bila je od 103,72 kg, masa nakon klanja od 51,33 kg i prinos trupova od 49,49%. Udeo sporednih proizvoda u telesnoj masi nojeva je bio sledeći: glava 0,70%, koža 8,19%, noge 3,93%, jetra 1,48%, pluća 0,57%, srce 0,97%, pun mišićni želudac 8,46%, prazan mišićni želudac 4,39%, puna creva 10,96%, jednjak i traheja 0,46% i abdominalno masno tkivo 4,23%.

Dužina trupa (clavicula – os pubis) je bila 74,92 cm, a dužina bataka (os pubis – tibio torzalni zglob) 76,92 cm, obim bataka 62,83 cm i dužina vrata 81,33 cm. Udeo bataka u masi trupa nakon klanja je bio 31,19%, leđa 49,78%, grudi 15,04% i vrata 3,99%. Udeo mesa i kostiju bataka u masi trupa nakon klanja je bio 24,12% i 7,05%, respektivno, leđa 41,63% mesa i 8,14% kostiju, grudi 4,75% mesa i 10,29% kostiju. Udeo mesa u batak bio je 77,39%, a kostiju 22,61%, udeo mesa u leđima – 83,64% mesa, a kostiju 16,36% i udeo mesa u grudima 31,61% mesa, a kostiju 68,39%. Trupovi nojeva su sadržavali 70,50% mesa i 25,48% kostiju (ne računajući meso i kosti vrata).

Ključne reči: noj, randman, sporedni proizvodi.

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