CHANGES OF THE INTESTINAL WEIGHT AND LENGTH OF OSTRICHES (*STRUTHIO CAMELUS VAR. DOMESTICUS*) RAISED IN LATVIA FROM DAY 120 TO DAY 360 OF LIFE

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ABSTRACT
The dynamics of changes of an increase in the ostrich intestinal weight and length in postnatal ontogenesis provides a conception of the feed processing possibilities in some intestinal segments, which, in turn, influences the bird's general health condition and production yield. The aim of the research was to find out changes of the small and large intestinal weight and length growth in ostriches from day 120 to day 360 of life. This investigation included 120, 180, 240, and 360 days old 18 ostriches of both sexes, raised in Latvia. The absolute weight and length of the small and large intestine were established. The absolute total weight and length of intestines, the relative weight and length of small and large intestine, and the ratio of small and large intestinal weight to their length were calculated. The obtained data were statistically processed using SPSS 20.0 program. In each age group, the mean arithmetic value and standard error were calculated, and a one-way variance analysis with LSD was used for comparison of data agreement of age groups. The total intestinal weight of ostriches as well as the small and large intestinal absolute weight increased significantly from day 120 to day 240 of life ($p<0.05$), while further to day 360 there were no marked changes. However, the relative weight of the small and large intestine tended to decrease with ostriches advancing in age. The ratio of the large intestinal weight to that of the small intestine from day 120 to day 360 of life increased linearly from 2.8 to 3.7. The absolute length of ostrich small and large intestine increased significantly from day 120 to day 240 of life ($p<0.05$). The length of small intestine had a tendency to reduce from 41.8% on day 120 to 36.4% on day 360 of life; whereas the relative length of large intestine at this stage of age tended to grow from 58.2% to 63.6%. The ratio of the large intestinal length to that of the small intestine increased linearly from 1.4 on day 120 to 1.75 on day 360 of life. The total length of intestines increased two times over the research period, but a significant growth was observed from day 120 to day 240 of life ($p<0.05$).

KEY WORDS: ostrich, growth, intestine, weight, length.

INTRODUCTION
African ostrich (*Struthio camelus var. domesticus*) is the largest and heaviest flightless bird in the world. It usually weighs from 63 to 130 kg; sometimes males are especially large and may reach 155 kg. Ostriches are herbivores, and in the wild, they feed on seeds, twigs of bushes, fruit, flowers, and rarely insects (Deeming, 1999). In birds, the small intestine is divided like in mammals, but the margins of the segments are not strictly separated; in herbivorous birds, the small intestine is longer than that in carnivorous ones. The main function of the small intestine is to digest and absorb the ingested feed (Whittow, 1999). The following anatomical peculiarities are observed in ratites: a large and long caecum, which is doubled and coil, a long colon with sacks and loops (Bezuidenhout, 1986). The large intestine of an adult ostrich is well developed, and it constitutes the largest part of the total intestinal weight (McLelland, 1989; Bezuidenhout, Wan Aswegen, 1990; Fowler, 1991; Clench and

Mathias, 1995; Порческу, 2007). In the large intestine, physiologically important processes of fiber fermentation takes place (Sales, 2006). The small intestine of an adult ostrich is on average 7.5m, but the large intestine – 16m long (Illanes et al., 2006; Whittow, 1999). In the world, several investigations have been carried out on the African ostrich intestinal anatomy in ontogenesis up to 100 days of life as well as in adult ostriches but there is comparatively little information on the intestinal masometric and morphometric changes at the age from day 100 to the adult bird. In Latvia, research has been carried out on the development of ostrich chicks' stomach and small intestine until day 60 of life (Duritis et al., 2010). The current study continues investigation on the development of ostrich chicks', raised in Latvia, intestine in the next period of postnatal ontogenesis. The aim of the research was to find out changes of the small and large intestinal weight and length growth in ostriches from day 120 to day 360 of life.

MATERIAL AND METHODS

This study used 120, 180, 240, and 360 days old 18 ostriches of both sexes. Ostriches were raised in Latvia on the ostrich farm *Ozolini AB* (Krustpils region Atasiene district), on the ostrich farm *Indrani* (Sigulda region More district), and in the department of experimental animals of the Faculty of Veterinary Medicine of Latvia University of Agriculture. The welfare requirements were taken into account for the swift-running birds with air temperature of 20-22 ^{0}C, air moisture content of 43% - 50%, and light intensity from 7 a.m. to 9 p.m. in the evening. Ostrich chicks until two months of age were fed on young birds feed *Strus Premium – Strus 1* that was gradually changed for the Latvian producer's *Tukuma straume* biologically complete feed of young birds. Oat and wheat corns, barley meal, ground seashells, *Dolfos D* mineral substances, and vitamins were added. Feed, water and gravel stones were available *ad libidum*. Birds were slaughtered, bodies weighted, and necropsy performed for further examination. The small and large intestinal absolute weight was determined using scale *Kern EW 42 0- 3 NM* (±0.01g), and the total weight of intestinal tract, relative weight of small and large intestine as well as the ratio of the small intestine to the large intestine were calculated. When determining the intestinal weight, their content was not evacuated. The absolute length of the small and large intestine was measured with a tape-measure (±1mm), and the total length of intestines, the relative length of the small and large intestine as well as the length ratio of the small intestine to the large intestine were calculated. The obtained data were statistically processed using SPSS 20.0 program. In each age group, the mean arithmetic value and standard error were calculated. To find out the significance of differences in various age stages, a one-way variance analysis with LSD was used for comparison of data agreement of age groups.

RESULTS AND DISCUSSION

A linear growth of the small and large intestine as well as the total absolute intestinal weight and length was observed over the investigated perinatal period ($p<0.001$).

The absolute weight of the small intestine increased significantly ($p<0.05$) 5.3 times from 240.6 ± 69.8g on day 120 to 1268.1 ± 5.7g on day 240 of life, but after that weight changes were insignificant, and on day 360 of life it was 1289 ± 74.5g (see Fig. 1). Other authors have described a similar result of studies when on day 334 of life their weight made up1051.7g (Wang and Peng, 2008).

The relative small intestinal weight decreased with ostriches advancing in age from 4.9 ± 1.0% on day 120 to 1.7 ± 0.3% on day 360 of life (see Fig. 2). Several authors have indicated the growth of small intestinal weight at the previous stage of age from 4.9% on day 30 (Duritis et al., 2010) to 5.9% on day 45 of age (Wang and Peng, 2008), and then a decrease

from 4.2% on day 72 (Iji et al., 2003) to 1.2% on day 334 of life (Wang and Peng, 2008). In adult ostriches, the relative weight of the small intestine is 1.1% (Порческу, 2007), and our research results confirm this tendency.

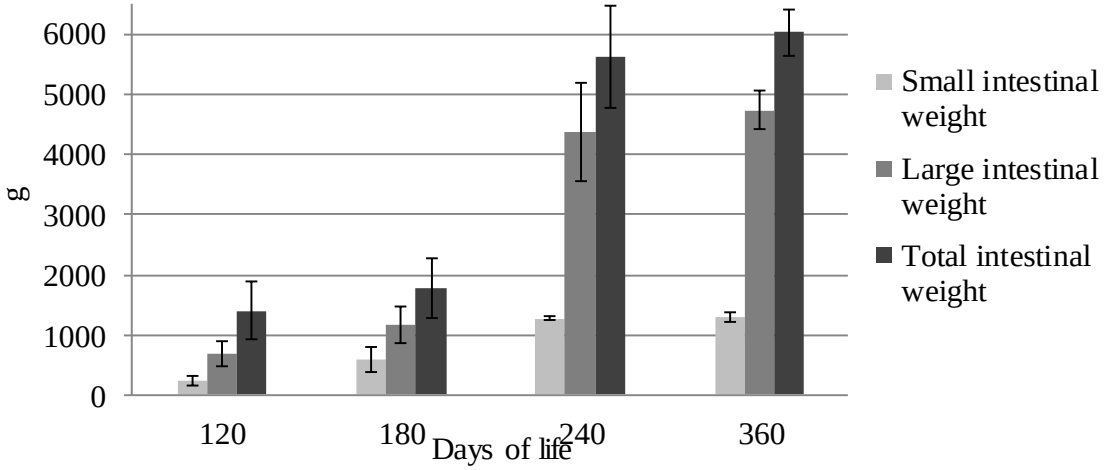

Figure 1. **The absolute weight of the small and large intestine (g±SEM) of ostriches from day 120 to day 360 of life**

The absolute weight of the large intestine increased seven times from 684.3 ± 196.6g on day 120 to 4745.6 ±306.8g on day 360 of life. Its growth was significant ($p<0.05$) from 1174.0 ±3 04.9g on day 180 to 4366.2 ± 819.3g on day 240 of life (see Fig. 1). The relative weight, in turn, of the large intestine decreased with ostriches advancing in age from 10. 1± 1.8% on day 120 to 6.5 ± 1.2% on day 360 of life (see Fig. 2). Other authors have described the growth of the relative weight until day 30 of life when it constitutes 13.6% (Duritis et al., 2010), and 20% on day 55 of life (Iji et al., 2003), but with age a decrease of the relative weight is observed, and until day 60 it reaches 8.9% (Duritis et al., 2010). In adult ostriches, the relative weight of large intestine is 3.2% of the body weight (Порческу, 2007), that is reflected in our research too. The ratio of the large intestinal weight to that of the small intestine from day 120 to day 360 of life increased linearly from 2.8 to 3.7.

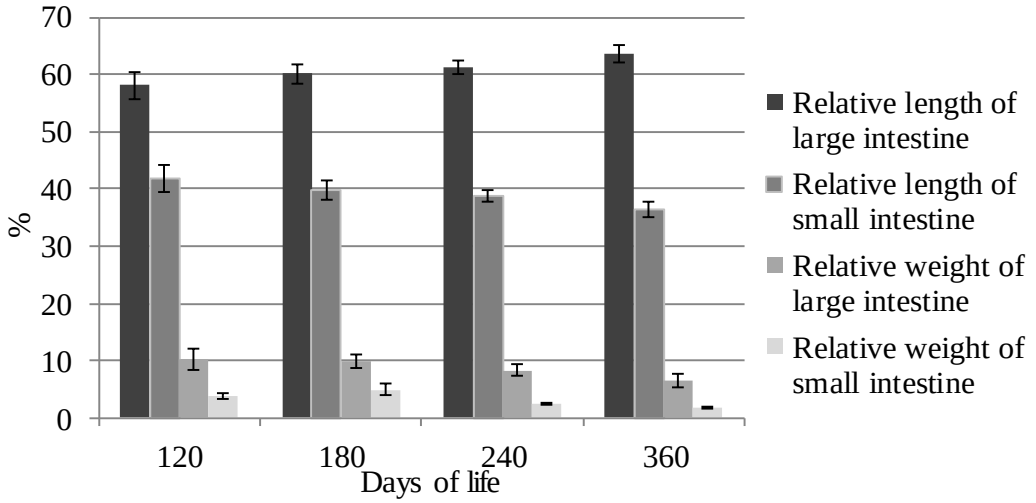

Figure 2. **The relative weight and length of the small and large intestine (%SEM) of ostriches from day 120 to day 360 of life**

The relative weight of the small and large intestine of ostriches reaches their maximum on day 41 and day 55 of life, whereas that of broilers reaches its maximum already in the first two weeks of life (Iji et al., 2003; Uni, 1995). The rapid development of broilers can be explained by the fact that they reach the needed slaughter weight already on day 40 of life but ostriches reach it only about at the age of one year.

The total absolute intestinal weight over the research period increased 4.3 times, i.e. from 1405.1 ± 479.7g on day 120 to 6035.4 ± 375.2g on day 360 of life. A significant growth of the absolute intestinal weight 3.2 times ($p<0.05$) was observed from 1770.3 ± 791.1g on day 180 to 5634.3 ± 852.3g on day 240 of life (see Fig. 1). Duritis (Duritis et al., 2010) has stated that the total absolute intestinal weight in Latvia raised ostrich chicks on day 60 is 593.6g that is two times less than in our investigation on day 120 of life, i.e. 1405.1 ±4 79.7g.

The absolute length of the small intestine increased significantly from day 120 to day 240 of life ($p<0.05$) by 1.8 times, i.e. from 3298.3 ± 352.6 mm on day 120 to 6080.0 ± 142.4 mm on day 240 of life. Whereas from day 240 to day 360 of life, the absolute small intestinal length increased only a little (see Fig. 3). At the age of 60 days, the absolute small intestinal length had reached 2960 mm (Duritis et al., 2010) that was half as much than on day 120 of life in our study. Other authors have established that in an adult ostrich, length of the small intestine is within the range from 6150 to 8150mm (Illanes et al., 2006; Skadhauge et al., 1984).

The relative length of the small intestine decreased from 41.8 ± 2.4% on day120 to 36.4 ± 1.5% on day 360 of life (see Fig. 2). Other authors have also found out that the relative length of the small intestine in the ostrich is 36% of the total intestinal length, but in the emu, it is 90% (Fowler, 1991). The small intestinal length indicates the feed composition; it is smaller in insectivores (emu) and birds of prey, larger in herbivores (ostriches) and piscevores (Whittow, 1999).

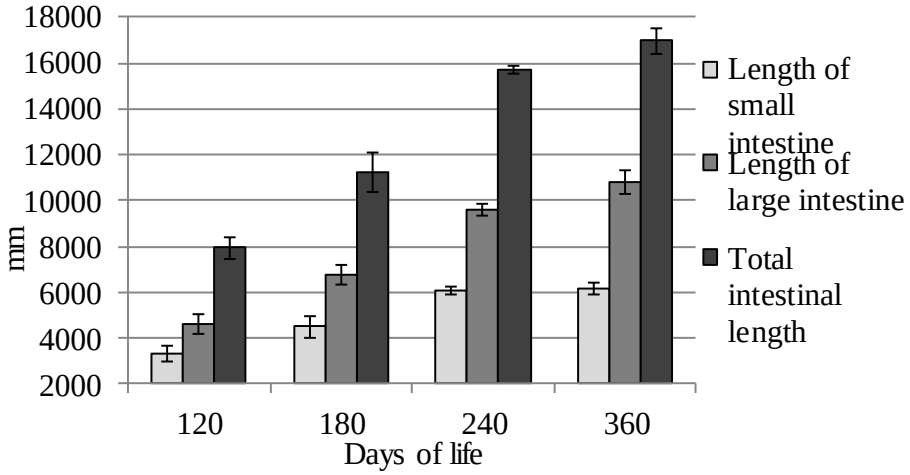

Figure 3. **The absolute length of the small and large intestine (mm±SEM) of ostriches from day 120 to day 360 of life**

The absolute and relative length of the large intestine over the observed period of ontogenesis increased 2.4 times from 4589.7±433.9 or 58.2 ± 2.4% on day 120 to 10797.2 ± 486.9mm or 63.6 ± 1.5% on day 360 of life (see Fig. 2 and 3). A significant growth ($p<0.05$) we observed from 4589.7 ± 433.9mm on day 120 to 9617.5±249.4mm on day 240 of life. Other authors also have established that the relative length of the large intestine in adult ostriches is 64% of the total intestinal tract length; whereas in the emu, it is only 9 - 10% (Cho et al., 1984; Fowler, 1991) that could be dependent on the type of feed. The absolute length of

the large intestine in an adult ostrich is 11100 - 13100mm (Skadhauge et al., 1984) that is also confirmed by our research. In the first months of life, the large intestine makes the largest part of the total intestinal length, and on day 60 of life the ratio of the large intestinal length to that of the small intestine is already 1.7 (Duritis et al., 2010). We detected a similar ratio also in the following age stages. It should be pointed out that the ratio of the large and small intestinal length from day 120 to day 360 of age increased linearly from 1.4 to 1.75.

The current study estimated that the total intestinal length of ostriches increased two times from day 120 to day 360 of life, i.e. from 7936.3 ± 479.1mm to 16962.5 ± 542.9mm (see Fig. 3). A significant growth of the total intestinal length ($p<0.05$) was observed from day 120 to day 240 of life (7936.3 ± 479.1 to 15697.5 ± 176.7mm). It is worth saying that the growth was comparatively slower than at the previous stages of age from day 38 of embryonic development to day 60 of life when the intestinal length increased 6.7 times (Duritis et al., 2010).

CONCLUSIONS

1. The total intestinal weight of ostriches as well as the absolute weight of the small and large intestine increased significantly from day 120 to day 240 of life ($p<0.05$) but further until day 360 of life marked changes were not observed. The relative weight, in turn, of the small and large intestine tended to decrease with ostriches advancing in age. The ratio of the large intestinal weight to that of the small intestine from day 120 to day 360 of life increased linearly from 2.8 to 3.7.
2. The absolute length of the small and large intestine increased significantly from day 120 to day 240 of life ($p<0.05$). The relative length of the small intestine tended to decrease from 41.8% on day 120 to 36.4% on day 360 of life, while the relative length of the large intestine at this stage of age tended to grow from 58.2% to 63.6%. The ratio of the large intestinal length to that of the small intestine increased linearly from 1.4 on day 120 to 1.75 on day 360 of life. The total intestinal length increased two times over the period of investigation, but a significant growth was observed from day 120 to day 240 of life ($p<0.05$).

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