7. Методичні вказівки по санітарно-мікологічній оцінці і поліпшенню якості кормів / А.Ф. Ображей, Л.І. Погребняк, О.Ф. Корзуненко та ін. // Київ, 1998. – 107 с.

8. Малинин О.А. Ветеринарная токсикология : учеб. пособ. [для студ. высш. учеб. заведений] / О.А. Малинин, Г.А. Хмельницкий, А.Т. Куцан. – Корсунь-Шевченковский: ЧП Майданченко, 2002. – 464 с.

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MORPHOMETRIC IDENTIFICATION OF *TRICHURIS SUIS* EGGS ISOLATED FROM DIFFERENT BIOLOGICAL SUBSTRATES

Trichuriasis of pigs is common nematodosic invasion in different climatic zones around the world. The morphobiological identification of this pathogen by morphometric parameters of helminth eggs remains understudied issue. The object of this study was to examine and compare the average sizes of structural parts of Trichuris suis eggs isolated from the gonads of female worms and faeces of sick animals. The analysis showed that the average sizes of eggs isolated from gonads of female trichurises are: length – 65.08±1.54 μm, width – 30.76±1.15 μm, the length of caps – 7.78±1.13 μm, its width – 10.69±1.19 μm; egg shell thickness – 3.26±0.82 μm. In eggs, isolated from the faeces of sick pigs there were registered increasing of their length ($p<0.01$), width and caps ($p<0.05$) but shells were thinned.

Keywords: *trichuriasis, pigs, eggs of helminth, morphometry.*

Introduction. Among the main fields that provide people around the world by meat products, the significant share belong to pig breeding. In the total meat production the pork share is over 40%. Now in Ukraine there are two categories of producers mainly engage in the pork production: homestead farms and agricultural enterprises. In homestead and small farms it is held more than 50 % of pig live-stock of the total number of animals [1–3]. Due to the fact that small private farms don't have the modern technology of pigs raising, it is created the threat of spreading of invasive diseases, among which intestinal nematodosiss have a special place, including trichuriasis [4, 5].

According to modern nomenclature *Trichuris suis* belong to type *Nemathelminthes* (Schneider, 1873), class *Nematoda* (Rudolphi, 1808), order *Trichurida (Trichocephalida)* (Skrjabin et Schulz, 1928; Spassky, 1954), subrow *Trichurata (Trichocephalata)* (Skijabin et Schulz, 1928), superfamily *Trichuroidea (Trichocephaloidea)* (Spassky, 1954), family *Trichuridae (Trichocephalidae)* (Baird,

1853), subfamily *Trichurinae (Trichocephalinae)* (Ransom, 1911), genus *Trichuris (Trichocephalus)* (Schrank, 1788) [6, 7].

Reports of researchers testify about the invasibility of animals by *T. ovis, T. skrjabini, T. capreoli* (specific for ruminants) [8], *T. vulpis* (specific for dogs, foxes), *T. georgicus* (specific only for foxes) [9, 10], *T. suis* (specific for pigs) species [11] and by *T. trichiurus* (specific for human) and *T. vulpis* species [9], which stresses the importance of more in-depth study of this invasion, especially in pigs.

One of the specific features of *Trichuris suis* eggs of pigs is their size. Most researchers propose such indexes as the length and width of the eggs. However, biometric indexes received by them have different significances [12, 13].

Thus, morphometric parameters of *Trichuris suis* eggs are very important to identify the pathogen invasion and determining its biological properties.

The goal of the work was to examine and compare the morphometric parameters of eggs *Trichuris suis*, isolated from a variety of organic substrates for the efficient identification.

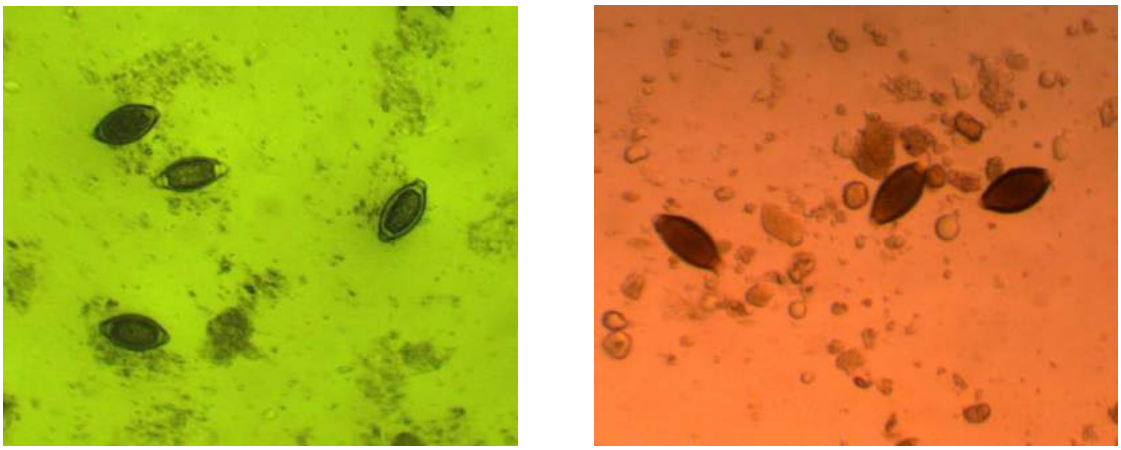
Materials and methods of research. The study was carried out at the research laboratory of the Department of Parasitology and Veterinary-Sanitary Expertise of the Faculty of Veterinary Medicine of the Poltava State Agrarian Academy. Some studies were carried out in the pathological-morphological department of the Regional State Veterinary Laboratory in Poltava region (Ukraine).

The determinations of morphological and metric parameters were performed on not invasion eggs of *Trichuris suis* of eggs received from different biological substrates, from final sections of uterus (gonads) females of *Trichuris suis* (Eu, n=50) and faeces of sick pigs (Ef, n=50) by flotation method [14]. It has been determined the shape, structure, color, surface of membrane, length, width of eggs, length and width of caps at the poles and the thickness of the shell.

To measure metric characteristic of isolated *Trichuris suis* eggs it was used ImageJ for Windows® (version 2.00) software using an objective (×16) and photoeyepiece (×10). To calibrate the analyzer of pictures it has been used image projection of line divisions of eyepiece-micrometer on the line of facility-micrometer of that MikroMed microscope. Microphotography was taken using a digital camera of for the microscope MikroMed 3Mpix (China) [15].

The statistical analysis of the results of experimental studies was conducted using the table of Student's t-test [16].

Results of research and discussion. As a result of studies it was found out that *Trichuris suis* eggs isolated from the gonads of female helminth and received from faeces of sick animals had a specific structure which is typical for this species and don't differ morphologically (Fig. 1).



A **B**

Figure 1. Eggs of *Trichuris suis*: A – isolated from the gonads of female helminth, B – isolated from pig faeces of sick animals (× 80).

They have the ellipse-elongated form with smooth narrowing at the ends. Outside they are covered with a thick smooth shell. At the poles eggs there were transparent caps. The shell of eggs were solid, thick, clearly viewed. Ef had a yellow-brown color, filled with germ cells of a darker color inside. However, Eu were painted in gray color from light to dark shades.

Morphometric parameters of *Trichuris suis* eggs were characterized by certain values that can be used to identify the pathogen infestations in pigs (Table 1).

Table 1

Metric characteristics of eggs of *Trichuris suis* (n=100)

Indexes		Min	Max	M±m
Length of egg, μm	Eu	58.67	71.66	65.08±1.54
	Ef	62.00	76.00	70.30±0.50**
Width of egg, μm	Eu	27.01	33.97	30.76±1.15
	Ef	30.00	36.00	32.60±0.22
Length of cap, μm	Eu	4.84	10.21	7.78±1.13
	Ef	7.00	13.00	10.30±0.14*
Width of cap, μm	Eu	7.80	13.83	10.69±1.19
	Ef	9.00	14.00	11.20±0.13
The thickness of the shell, μm	Eu	2.36	4.68	3.26±0.82
	Ef	2.00	4.00	2.90±0.10

Note: *p < 0.05, **p < 0.01 compared with the sizes Eu.

It has been determined that metric indexes of *Trichuris suis* eggs, isolated from the gonads of female worms and obtained from faeces of sick pigs differed significantly. Thus, Eu had the following parameters: length and width of the eggs were 65.08±1.54 μm and 30.76±1.15 μm (Fig. 2 A), length and width of caps – 7.78±1.13 μm and 10.69±1.19 μm (Fig. 2 B), the thickness of the shell – 3.26±0.82 μm (Figure 2 C). However, the length of the eggs (Figure 2 D) and caps Ef (Figure 2 E) were higher at 7.43% (70.30±0.50 μm, $p<0.01$) and 24.47% (10.30±0.14 μm, $p<0.05$) than in those of Eu. At the same time *Trichuris suis* eggs isolated from faeces of sick pigs had greater significant of eggs width (Fig. 2 D) and caps (Fig. 2 E) at 5.64% (32.60±0.22 μm) and 4.55% (11.20±0.13 μm) respectively

and smaller – the thickness of the shell (Fig. 2 F) at 11.04% (2.90±0.10 μm) compared to Eu.

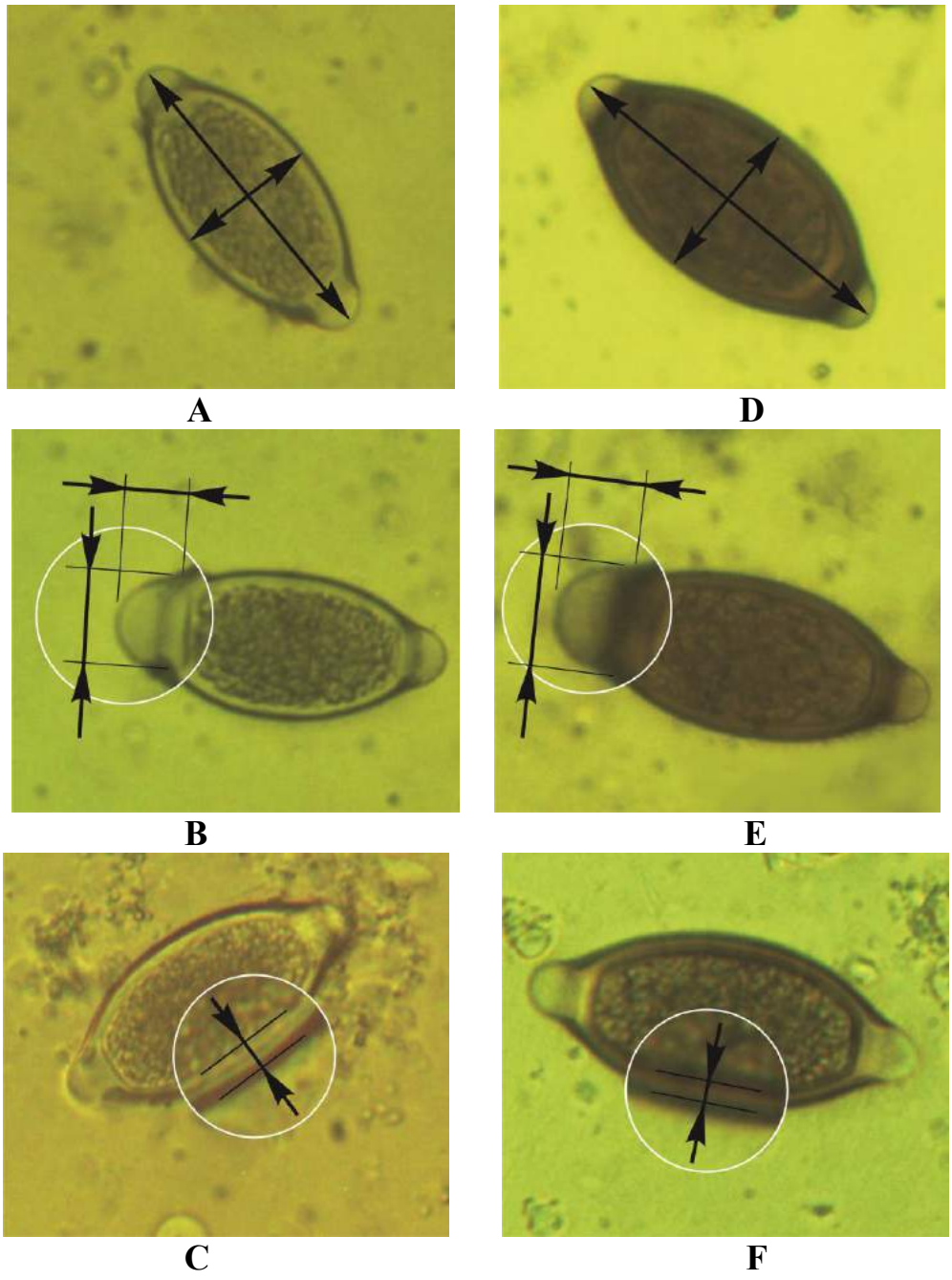


Figure 2. Morphometric parameters of Trichuris suis eggs: Eu (A–C) – the length and width of the egg (A), length and width of cap (B), the thickness of the shell (C); Ef (D–F) – the length and width of the egg (D), length and width of the cap (E), the shell thickness (F) (× 400).

Trichuris suis eggs, isolated from different biological substrates were morphologically indistinguishable. They had a specific structure of this type, but with a different color. *Trichuris suis* eggs isolated from the gonads of female worms are colored in different shades of gray, and eggs received from faeces of sick pigs – in yellow-brown. This morphological structure of *Trichuris suis* eggs of pigs is confirmed by other authors [14, 17, 18].

It was identified the pathogen invasion by sizes of eggs, which included not only measure the length and width of the eggs, but the proposed measure of the width and the length of caps and thickness of the shell. Thus, the average indices length of Eu was 65.08±1.54 μm, their width – 30.76±1.15 μm, the length of caps – 7.78±1.13 μm, its width – 10.69±1.19 μm; egg the shell thickness of eggs – 3.26±0.82 μm. However, the length of Ef was 70.30±0.50 μm, their width – 32.60±0.22 μm, the length of caps – 10.30±0.14 μm, its width – 11.20±0.13 μm, the thickness of the shell of eggs – 2.90±0.10 μm. The data did not differ in length and width indexes *Trichuris suis* eggs from the results of studies of different researcher [14, 19, 20], who studied the size of eggs obtained from female gonads of *Trichuris suis* of pigs.

Similar measurements of sizes of helminth eggs, their caps and thickness of the shell of eggs were carried out only on *Trichuris suis* eggs of cattle received from the gonads of female worms [21] and *Trichuris suis* eggs of pigs obtained from pig faeces of sick pigs [22].

Scientists of France and Brazil analyzed morphometric parameters of eggs *T. suis*, obtained by various researchers during 1938–1994. They proved that eggs of pathogen of *Trichuris suis* of pigs vary in the size due to changes in living conditions (climatic, geographical, waste, technological, etc.) as a factor of parasites adaptation [12].

We proved that the size of eggs of *Trichuris suis*, isolated from the gonads of female worms significantly changed metrically and statistically from eggs of similar sizes isolated from the faeces of sick pigs. In the last ones eggs had increased length ($p<0.01$), width, their caps ($p<0.05$), and thinning the shell.

Conclusion and prospect for further research. In conclusion he can note that the study has made the possibility to determine the identity of morphometric size of eggs of the *Trichuris suis* species in Ukraine, which includes a significant number of parameters including methods of obtaining *Trichuris suis* eggs of pigs. These data may indicate that the sizes of eggs vary in the process since their separation from the gonads of female worms in the lumen of large intestines of pigs and subsequent passage through the intestines and the excretion of faeces into the environment. These data should be considered at determining the metric parameters of pathogens of invasion that will improve their identification.

REFERENCES

1. Shust, O.A. (2011). Ekonomichni zasady vyrobnytstva ta realizatsii produktsii svynarstva v silskohospodarskykh pidpryiemstvakh [The economic principles of production and sales of products of pig breeding in agricultural enterprises]. *Stalyj rozvytok ekonomiky – Sustainable development of economics, 1 (4)*, 276–280 [in Ukrainian].

2. Talavyria, M.P. & Talavyria, O.M. (2012). Teoretychni osnovy efektyvnosti vyrobnytstva svynyny u rynkovykh umovakh [Theoretical foundations of the efficiency of pork production in market conditions]. *Ekonomika APK – Economy AIC, 3,* 49–53 [in Russian].

3. Barutzki, D., Randelzhofer, A. & Gothe, R. (1992). The incidence of helminth infections in uterus and piglets in Southern Germany. *Tierarztliche Umschau, 42 (3),* 179–190.

4. Safyullyn, R.T. (1997). Parazitarnye bolezni svinej [Parasitical diseases of pigs]. *Veterinarija –Veterinary, 1,* 28–30 [in Russian].

5. Nejsum, P., Thamsborg, S.M., Petersen, H.H., Kringel, H., Fredholm, M. & Roepstorff, A. (2009). Population dynamics of *Trichuris suis* in trickle-infected pigs. *Parasitology, 136,* 691–697.

6. Jenkins, T. (1969). Electron microscope observations of the body wall of *Trichuris suis* Schrank 1788. (Nematoda: Trichuroidea). The cuticle and Bacillary band. *Z Parasitenk, 32,* 374−387.

7. Andrassy, I. (1976). *Evolution as basis for the systematization of nematodes*. Budapest, Acad. Kiaodo.

8. Pasechnik, V.E. (1986). Novoe v morfologii Trichocephalus skijabini (Baskakov, 1924) [New in morphology of Trichocephalus skijabini (Baskakov, 1924)]. *Bjulleten Vsesojuznogo instituta gelmintologii – Bull. All. In. Helmyntology, 43,* 79. [in Russian].

9. Kenney, M., Yermakov, V. (1980). Infection of man with *Trichuris vulpis*, the whipworm of dogs. *American Journal of Tropical Medicine and Hygiene, 29 (6),* 1205–1208.

10. Rodonaya, T.E. (1970). *Trichocephalus georgicus spec. nov*., occurring in predatory animals in Gruzia. *Soob. Akad. Nauk Gruz. SSR, 11,* 251–254.

11. Beer, R.J.S. (1970). The relationship between *Trichuris trichiura* (Linnaeus 1758) of man and *Trichuris suis* (Schrank 1788) of the pig. *Res Vet Sci, 20,* 47–54.

12. Rocha, G.C., Harter-Lailheugue, S., Le Bailly, M., Araújo, A., Ferreira, L.F., Serra-Freire, N.M. et al. (2006). Paleoparasitological remains revealed by seven historic contexts from "Place d'Armes", Namur, Belgium. *Mem Inst Oswaldo Cruz, Rio de Janeiro, 101 (Suppl. II),* 43–52.

13. Pasechnik, V.E. (1997). Ultrastructure of eggs surface of the genus Trichocephalus Schrank, 1788: *Second English language International Nematology Simposium of the Society of Nematologist: Moscow.* (p. 20).

14. Kotelnikov, G.A. (1984). *Gelmintologicheskie issledovanija zhivotnyh i okruzhajushhej sredy [Helminthological studies of animals and environment]*. Moscow [in Russian].

15. Goralskii, L.P., Khomych, V.T., & Kononskii, O.I. (1980). *Osnovy gistologichnoii tehniky i morfofunkcionalni metody doslidzhennja u normi ta pry patologii [Bases of histological techniques and morphological methods of researches in normal and pathological conditions]*. Zhitomir: DAEU [in Ukrainian].

16. Marinin, E.A. (1980). *Biometricheskaja obrabotka laboratornyh, klinicheskih i jepizootologicheskih dannyh [Biometric treatment of laboratory, clinical and epizootic data]*. Novocherkassk. [in Russian].

17. Pittman, J.S., Shepherd, G., Thacker, B.J., Myers, G.H. (2010). *Trichuris suis* in finishing pigs: Case report and review. *J Swine Health Prod, 18 (6),* 306–313.

18. Olekhnovich, N.I., & Yatusevich, A.I. (2001). *Trihocefalez svinej [Tryhotsefalez of pigs]*. Vitebsk: VYHVAM [in Russian].

19. Mozgovoii, A.A. (1967). *Gelminty domashnih i dikih svinej i vyzyvaemye imi zabolevanija [Helminth of domestic and wild pigs and diseases caused by them]*. Moscow [in Russian].

20. Ryzhikov, K.M., Oshmarin, P.G., & Khrustalev, A.V. (1983). *Opredelitel gelmintov domashnih i dikih svinej [The determinant of helminth of domestic and wild pigs]*. Moscow [in Russian].

21. Yevstafieva, V., Shevchenko, T. (2015). Morfometrychni pokaznyky jajec tryhurysiv VRH [Morphometric indexes of *Trichuris suis* eggs of cattle]. *Tvarynnyctvo Ukrainy – Tvarynnytstvo of Ukraine, 9,* 36–38 [in Ukrainian].

22. Melnychuk, V. (2014). Morfometrychna harakterystyka jajec tryhurysiv svynej [Morphometric characteristics eggs of *Trichuris suis* in pigs]. *Tvarynnyctvo Ukrainy – Tvarynnytstvo of Ukraine, 12,* 33–35 [in Ukrainian].

МОРФОМЕТРИЧЕСКАЯ ИДЕНТИФИКАЦИЯ ЯИЦ *TRICHURIS SUIS*, ВЫДЕЛЕННЫХ ИЗ РАЗЛИЧНЫХ БИОЛОГИЧЕСКИХ СУБСТРАТОВ / Евстафьева В., Мельничук В., Юськив И., Ложкина Е.

Трихуроз свиней является распространенной нематодозной инвазией в различных природно-климатических зонах многих стран мира. Морфобиологическая идентификация этого возбудителя по морфометрическим показателям яиц гельминтов остается недостаточно изученным вопросом. Объектом данного исследования было изучить и сравнить средние размеры структурных частей яиц Trichuris suis, выделенных из гонад самок гельминтов и фекалий больных животных. Проведенный анализ показал, что средние размеры яиц, выделенных из гонад самок трихурисов, составили: длина – 65,08±1,54 мкм, ширина – 30,76±1,15 мкм, длина крышечки – 7,78±1,13 мкм, ее ширина – 10,69±1,19 мкм; толщина оболочки яиц – 3,26±0,82 мкм. Морфометрически у яиц, выделенных из фекалий больных свиней, увеличивается длина ($p<0,01$) и ширина яиц и их крышечек ($p<0,05$), истончается оболочка.

Ключевые слова: *трихуроз, свиньи, яйца гельминтов, морфометрия*

МОРФОМЕТРИЧНА ІДЕНТИФІКАЦІЯ ЯЄЦЬ *TRICHURIS SUIS*, ВИДІЛЕНИХ З РІЗНИХ БІОЛОГІЧНИХ СУБСТРАТІВ / Євстаф'єва В., Мельничук В., Юськів І., Ложкіна О.

Вступ. *Однією зі специфічних ознак яєць трихурисів свиней є їх розміри. Більшість дослідників пропонують такі показники як довжина та ширина яєць. Однак, отримані ними біометричні показники мають різні значення.*

Отже, морфометричні показники яєць Trichuris suis дуже важливі для ідентифікації збудника інвазії, а також визначення його біологічних властивостей. Метою наших наукових досліджень було визначення морфометричних показників яєць трихурисів свиней, виділених з різних біологічних субстратів, з урахуванням їх будови.

Матеріали і методи досліджень. *Визначення морфологічних та метричних параметрів проводили на неінвазійних яйцях трихурисів свиней, які отримували з різних біологічних субстратів: із кінцевих відділів маток (гонад) самок трихурисів (Ям, n=50) та з фекалій хворих свиней (Яф, n=50) флотаційним методом. Визначали форму, структуру, колір, характер поверхні оболонки, довжину, ширину яєць, довжину та ширину кришечок на полюсах, а також товщину оболонки.*

Результати досліджень та їх обговорення. *Встановлено, що метричні показники яєць* Trichuris suis*, виділених з гонад самок гельмінтів та отриманих з фекалій хворих свиней, значно відрізнялися. Так, параметри Ям мали наступні показники: довжина та ширина яєць становила 65,08±1,54 мкм та 30,76±1,15 мкм, довжина і ширина кришечки – 7,78±1,13 мкм та 10,69±1,19 мкм, товщина оболонки – 3,26±0,82 мкм. Разом з тим, довжина яєць та кришечки Яф були більшими на 7,43% (70,30±0,50 мкм, $p<0,01$) та 24,4 % (10,30±0,14 мкм, $p<0,05$) порівняно з аналогічними показниками у Ям. Одночасно яйця трихурисів, виділені з фекалій хворих свиней, мали більші значення ширини яєць та кришечки на 5,64% (32,60±0,22 мкм) та 4,55% (11,20±0,13 мкм) відповідно, і менші – товщини оболонки на 11,04% (2,90±0,10 мкм) порівняно з Ям.*

Нами доведено, що розміри яєць Trichuris suis, виділених з гонад самок гельмінтів, метрично змінюються і статистично достовірно відрізняються від аналогічних розмірів яєць, виділених з фекалій хворих свиней. У останніх збільшується довжина ($p<0,01$) і ширина яєць та їх кришечок ($p<0,05$), потоншується оболонка.

Ключові слова: *трихуроз, свині, яйця гельмінтів, морфометрія*

СПИСОК ЛИТЕРАТУРИ

1. Шуст О. А. Економічні засади виробництва та реалізації продукції свинарства в сільськогосподарських підприємствах / О. А. Шуст // Сталий розвиток економіки. – 2011. – № 1 (4). – С. 276–280.
2. Талавиря М. П. Теоретичні основи ефективності виробництва свинини у ринкових умовах / М. П. Талавиря, О. М. Талавиря // Економіка АПК. – 2012. – № 3. – С. 49–53.
3. Barutzki D. The incidence of helminth infections in sows and piglets in Southern Germany / D. Barutzki, A. Randelzhofer, R. Gothe // Tierarztliche Umschau. – 1992. – V. 42, № 3. – P. 179–190.
4. Сафиуллин Р. Т. Паразитарные болезни свиней / Р. Т. Сафиуллин // Ветеринария. – 1997. – № 1. – С. 28–30.
5. Population dynamics of *Trichuris suis* in trickle-infected pigs / P. Nejsum, S. M. Thamsborg, H. H. Petersen [et al.] // Parasitology. – 2009. –Vol. 136. – P. 691–697.
6. Jenkins T. Electron microscope observations of the body wall of Trichuris suis Schrank 1788. (Nematoda: Trichuroidea). The cuticle and Bacillary band / T. Jenkins // Z Parasitenk. − 1969. − Vol. 32. − P. 374−387.
7. Andrassy I. Evolution as basis for the systematization of nematodes / I. Andrassy. – Budapest, Acad. Kiaodo, 1976. – 288 p.
8. Пасечник В. Е. Новое в морфологии Trichocephalus skijabini (Baskakov, 1924) / В. Е. Пасечник // Бюл. Всес. ин-та гельминтол. – 1986. – Вып. 43. – С. 79.
9. Kenney M. Infection of man with Trichuris vulpis, the whipworm of dogs / M. Kenney, V. Yermakov // American Journal of Tropical Medicine and Hygiene. – 1980. – V. 29, № 6. – P. 1205–1208.
10. Rodonaya T. E. Trichocephalus georgicus spec. nov., occurring in predatory animals in Gruzia / T. E. Rodonaya // Soob. Akad. Nauk Gruz. SSR. – 1970. – Vol. 11. – P. 251–254.
11. Beer R. J. S. The relationship between *Trichuris trichiura* (Linnaeus 1758) of man and *Trichuris suis* (Schrank 1788) of the pig / R. J. S. Beer. Res Vet Sci. – 1976. – Vol. 20. – P. 47–54.
12. Paleoparasitological remains revealed by seven historic contexts from "Place d'Armes", Namur, Belgium / Gino Chaves da Rocha, Stephanie Harter-Lailheugue, Matthieu Le [et al.]. –Mem Inst Oswaldo Cruz, Rio de Janeiro. – 2006. – Vol. 101 (Suppl. II). – P. 43–52.
13. Pasechnik V. E. Ultrastmcture of eggs surface of the genus *Trichocephalu*s Schrank, 1788 / V. E. Pasechnik // Second English language International Nematology Simposium of the Societi of Nematologist. – Moscow, 1997. – P. 20.
14. Котельников Г. А. Гельминтологические исследования животных и окружающей среды / Г. А. Котельников. – Москва: Колос, 1984. – 208 с.
15. Горальський Л. П. Основи гістологічної техніки і морфо функціональні методи дослідження у нормі та при патології / Л. П. Горальський, В. Т. Хомич, О. І. Кононський // Житомир: ДАЕУ, 2005. – 284 с.
16. Маринин Е. А. Биометрическая обработка лабораторных, клинических и эпизоотологических даннях: метод. руководство / Е. А. Маринин. – Новочеркасск, 1980. – 38 с.
17. Pittman J. S. *Trichuris suis* in finishing pigs: Case report and review / J. S. Pittman, G. Shepherd, B. J. Thacker, G. H. Myers // J Swine Health Prod. – 2010. – Vol. 18 (6). – P. 306–313.
18. Олехнович Н. И. Трихоцефалез свиней: монография / Н. И. Олехнович, А. И. Ятусевич. – Витебск: ВГВАМ., 2001. – 98 с.
19. Мозговой А. А. Гельминты домашних и диких свиней и вызываемые ими заболевания / А. А. Мозговой. – М.: Наука, 1967. – С. 418–426.
20. Рыжиков К. М. Определитель гельминтов домашних и диких свиней / К. М. Рыжиков, П. Г. Ошмарин, А. В. Хрусталев. – М.: «Наука», 1983. – С. 85–86.
21. Євстаф'єва В. Морфометричні показники яєць трихурисів ВРХ / В. Євстаф'єва, Т. Шевченко // Тваринництво України. – 2015. – № 9. – С. 36–38.
22. Мельничук В. В. Морфометрична характеристика яєць трихурисів свиней / В. В. Мельничук // Тваринництво України. – 2014. – № 12. – С. 33–35.