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Epidemiology of echinococcosis and changes in some chimical indicies of muscular tissue and liver of cattle in the Republic of Moldova

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Abstract

The study of the parasitological invasions with Echinococcus granulosus in about 8000 cattle have been carried out in different time periods (1986-1987, 2014-2015) in private farms, family household and specialized in milk and beef production farming sectors from the Republic of Moldova. The results of the parasitological research carried out in 1986-1987 have revealed the 33.6% incidence of echinococcosis in adult cattle from farming sectors, 60.6% incidence in farms and 76.5% in cattle from family household (mean 56.9%); the incidence related to bull-calves population (of 23-25 months old) were 8.3%, 17.7% and 21.1% correspondingly (mean 15.7%). In the period 2014-2015, after the restructuring carried out in the livestock, the results show that adult cattle from farms were infested at 74.6%, in individual sector - in 83.7% of cases (mean 79.2%) and young cattle (23-25 months old) - in 31.2% and 37.4% cases correspondingly (mean 34.3%). Compared to 1986-1987 the level of infestation of adult bovines increased, in average, with 22.3% and of young cattle with 18.6% which prove the existence of various outbreaks of parasitic agents (definitive hosts) and lack or irregular conducting of dehelmentization. It was determined that the infested with echinococcosis cattle produce less meat and eatable by-products. Moreover, the content of some vitamins (A, E, B_1, B_2, C), micro-, macroelements (Ca, Mg, Na, K, Fe, P), chemical indicies (humidity, dry solid matter, proteins, fat, mineral saults) in muscular and liver tussues proved to be considerably changed influencing considerably the animal products' nutrition value.

Key words: *cattle, Echinococcus granulosus, vitamines, micro-, macroelements in meat and liver, nutrition value.*

Introduction

In the last 2-3 decades in connection with land allotment, reorganization of breeding, creation of many medium and small farms, redeploying of large numbers of animals from complexes to private households radical changes of parasitic fauna occurred. Cattle that were kept indoors, moving to different grazing anthropogenic stations also entered in nature reserves, serving as sources of transmission of parasitic agents to wild animals. The limited space dislocation and grazing of different species and various ages also contributed at increasing of parasitic fauna.

Spassky A., Andreiko O. and Selivanova N. in 1962 studied the spreading of echinococcosis in the Republic of Moldova and have established that the invasion extensivity in cattle in that period constituted 86.0% and in swine – 66.61%.

Hirik M. and Pomirko T. (1975) mention that cattle slaughtered in meat processing factories in the republic in 1964 were infested with echinicoccus in 16.6% of cases and slaughtered cattle in 1973 - in 24.2% of cases. As the authors remark the invasion extensivity grew every year. If in the sixties there were established only few hydatic cysts in the liver and lungs, in the early seventies the invasion intensity increased, and they were detected in kidneys, spleen, and other organs. In most cases, the lungs and liver, because of infestation were destroyed.

Zgardan E.S. (1974) mention that in cattle 38 species of helminths were revealed. A uniformity was noted during their infestation with cestodes: in southern zone – 22.4%, central – 21.5% and in northern one – 23.3%.

The aim of the scientific research was to determine, in dynamics, the level of invasion with echinococcosis of the cattle depending on the age and maintenance techniques, as well as their impact on some chemical indexes, content of vitamins (A, E, B_1, B_2, C), micro- and macroelements (Ca, Mg, Na, K, Fe, P) in the muscular tissue and liver.

Materials and methods

The parasitological research have been carried out in about 8 thousand of cattle of different age purchased from the private and public households with various maintenance technologies and from different regions of Moldova and slaughtered in the meat processing plant during 1986-1987, 2014-2015.

The content of some vitamins (A, E, B_1, B_2, C), micro-, macroelements (Ca, Mg, Na, K, Fe, P), chemical indices (humidity, dry solid matter, proteins, fat, ashes) in muscular and liver was studied. The content of micro- and macroelements have been determined by use of the photoelectric colorimetry methods, and the composition of the vitamins have been defined using the spectrophotometric methods. In view of this 30 samples of muscular tissue as well as liver have been collected from healthy cattle and cattle infested with echinococcosis.

Results and discussions

The reforms realized in the animal production field of the Republic of Moldova in the last 20-30 years have lead to quantitative changes in the population of livestock: this have been reduced 2.5-3 times as compared to 1987. The ratio of the animals from the private sector by comparison to the public one considerably increases. Given that in 1987 the number of cattle in the private sector accounted up to 14.4% of the total number of the livestock population then already in 2015 this was increased up to 88.8% (table 1).

Table 1. Ratio between cattle population from household sector and private farms in the Republic of Moldova during 1987, 2015

Maintenance technology	1987	2015
Public sector, %	85.6	11.2
Private sector, %	14.4	88.8

There were described about 1200 species of parasites in the Republic of Moldova and over 100 are pathogenic for animals. Due to the fact that the animal fauna of Republic of Moldova is reach and the climate facilitates the development of various species of parasites, especially of helminthes, their study is essential for the monitoring of the sanitary, veterinary and epidemiological situation (Toderaș I., Vladimirov M., Neculiseanu Z., 2007).

Thus, in order to organize a complex program of measures for prophylaxis and treatment of parasitic invasions in animals its necessary, besides knowledge on etiology, pathogenesis, clinical status and treatment measures, to have data on the level of spreading of the various species of parasites related to animal age, its maintenance technologies, seasons etc. In this regard, the parasitological studies carried out in dynamics are of great importance.

The study of echinococcosis spreading in cattle have been carried out in different periods (1986-1987, 2014-2015) and geographic regions of the Republic of Moldova, in the specialized farms households, in the private sector and the complexes.

Parasitology research results obtained in 1986-1987 demonstrates that echinococcosis in adult bovine and young cattle is most commonly diagnosed in the individual sector (76.5%, 21.1%) and farms (60.6%, 17.7 %) (table 2).

Parasitological research results on echinococcosis extensivity in adult cattle (4-6 y.o.) and young cattle (23-25 months) purchased from various parts of the country and slaughtered in the period from 2014 to 2015, after restructuring carried out in the livestock sector, reveals that adult cattle were infested in 74.6% of cases in farms and in 83.7% of cases in the private sector, while young cattle respectively in 31.2% and 37.4% of cases (table 3).

Table 2. Level of infestation in adult cattle (4-6 y.o.) and in young cattle (23-25 months) depending on different maintenance technologies during 1986-1987

Age animals	Maintenance technology			
	Complexes, %	Farms, %	Private sector, %	Mean, %
Adult cattle (4-6 y.o.)	33.6	60.6	76.5	56.9
Bulls (23-25 months)	8.3	17.7	21.1	15.7

Table 3. Level of infestation in adult cattle (4-6 y.o.) and of young cattle (23-25 months) with echinococcus in 2014-2015

Age animals	Maintenance technology		
	Farms, %	Private sector, %	Mean, %
Adult cattle (4-6 y.o.)	74.6	83.7	79.2
Young cattle (23-25 months)	31.2	37.4	34.3

The level of infestation of adult bovines increased in average, with 22.3% and 18.6% bulls, compared to 1986-1987 and demonstrate the existence of various outbreaks of parasitic agents (definitive hosts) or irregular dehelmintization.

Echinococcosis play a leading role in the structure of parasitic diseases in animals. It also provoke a higher risk of transmitting parasitic diseases to humans, as well as reducing the quality of animal products. After analyzing the number of cases of humans surgical operations for Echinococcosis/ Hydatidosis in Moldova during 1980-2016, we have to mention that it increased in the last decades (table 4).

While performing the sanitary and veterinary expertise of carcasses and organs of the animals it is recommended to determine (in regard to the intensivity of invasion with echinococcosis) three levels of infestation: *low, medium* and *high.*

Low infestation occurs when in the animal is affected one third of the organ (liver, lung) with sporadic hydatids. In such cases there are no changes in the organ, with the exception of the destructive cells around hydatid cyst. Low infestation is more frequent established in young cattle, up to 2 years old (20-22%);

Medium infestation occurs when no more than half the organ is affected and several hydatid cysts are established (3-5) on the surface of the organ and inside it. Their size varies between 5-10 cm and parenchymal organ changes are observed, mainly in the hydatid cyst. This index is necessary to consider at sanitary-veterinary expertise of organs. Medium infestation is frequently determined in younger cattle of 2-4 years old (26-29%);

High infestation occurs where 2/3 or the whole organ is affected. On its surface or inside the organ there are multiple hydatid cysts of various sizes. Adult animals are affected more frequently (30-32%).

Thus, in slaughtered animals the low and medium intensity was determined more frequently.

Table 4. Number of (occasional) cases of surgical operations due to Echinococcosis/Hydatidosis in humans in the Republic of Moldova in 1980-2016 (Lungu V. et.al., 2016)

Years	Surgery cases	Years	Surgery cases	Year	Surgery cases
1980	64	1993	144	2006	135
1981	56	1994	183	2007	209
1982	49	1995	195	2008	140/12
1983	94	1996	188	2009	131/22
1984	96	1997	169	2010	167/19
1985	99	1998	215	2011	99/10
1986	105	1999	178	2012	118/9
1987	145	2000	175	2013	125/13
1988	156	2001	203	2014	88/22
1989	189	2002	228	2015	62/10
1990	195	2003	233	2016	55/4
1991	196	2004	200		
1992	149	2005	162		

Note: *nominator*- number of cases in adults; *denominator* - number of cases in children

There was determined the content of the vitamins A, E, B_1, B_2, C and micro- and macroelements - Ca, Mg, Na, K, Fe, P in order to establish the nutrition value of muscular tissue and liver in cattle infested with echinococcosis (table 5 and 6).

It was established that in infested cattle the content of vitamins A and E in liver decreased by about 3 times, of B_1 and B_2 - by 1.12 times and of C - by 1.59 times, of iron - by 2.64 times and of phosphorus - by 2 times, while of calcium increased by 3.42 times, of natrium - by 4.81 times, of magnesium – by 1.19 and of kalium - by 1.33 times in comparison to the non-infested animals.

Table 5. The content of vitamins in liver and tissues muscular in cattle infested with echinococosis (mkg/g)

Studied material	A	E	B_1	B_2	C
Liver:					
Healthy	0.14	0.35	1.16	1.23	24.5
Infested	0.05	0.12	1.04	1.10	15.4
Muscular tissue:					
Healthy	0.11	0.20	1.17	1.47	16.8
Infested	0.03	0.14	1.00	1.10	4.0

In meat the content of vitamin A was 3.67 tomes lower, of E – 1.43 times lower, of B_1 - 1.17, of B_2 - 1.34, of C – 4.20, of calcium – 1.69 times lower, while of magnesium was 1.39 times higher, of natrium – 1.53, of kalium - 1,34, of iron – 3.26 and of phosphorus – 1.14 times higher than in healthy cattle.

Table 6. The content of micro- and macroelements in liver and in tissue muscular infested with echinococcosis cattle *(g/100 g of mineral substances)*

Researched material	Calcium	Magnesium	Natrium	Kalium	Ferrum, (mg/100g)	Phosphorum, (%)
Liver:						
Healthy	1.17	1.21	1.30	9.38	752.50	2.50
Infested	4.00	1.44	6.25	12.50	285.00	1.25
Muscular tissue:						
Healthy	1.23	1.12	1.18	10.75	86.00	1.05
Infested	0.73	1.56	1.80	14.38	280.00	1.20

Echinococcosis in cattle leads to lower yields of meat and comestible by-products (table 7).

The obtained results indicate that in young cattle infected with echinococcus the content of meat has decreased by 10.6%, of fat - 10.1%, of by-products: liver - 45.5%, lungs - by 47.8% and in adult cattle, respectively decreased by 19.5%, 18.9%, 46.1% and 51.6%.

Table 7. Yield of meat and comestible by-products falling into first category obtained from infested with echinococcosis cattle.

Age category	Sample	The yield at cutting, kg			
		meat	fat	liver	lungs
Young cattle	Healthy	279.3	7.9	3.3	2.3
	Infested	249.7	7.1	1.8	1.2
Adult cattle	Healthy	222.5	9.5	3.9	3.1
	Infested	179.1	7.7	2.1	1.5

The veterinary expertise of carcasses and organs from cattle infected with various parasite agents that are not directly transmitted to humans, the affected organs partly or total, are validated, and the parties affected are destroyed and the non-affected parts a suitable for consumption as healthy ones without restrictions. The purpose of the research was to determine the content of chemical indices in meat and liver, depending on the intensity of infestation with echinococcus (table 8).

From the obtained results it follows that in cattle with low intensity of infestation with echinococcus the moisture content in meat increased by 1.8%, average - by 2.2%, those with high intensity of infestation - by 3.4% and in liver - 0.7%, 4.4% and 8.7% accordingly.

In cattle with low intensity of infestation the dry matter content in meat decreased by 5.0%, average - by 6.1%, with high intensity of infestation - 9.9% and in liver, respectively - by 1.66%, 10.27% and 16.89%.

The amount of protein in meat from cattle with low infestation intensity decreased with 0.5%, average - with 3.7% and those with high intensity of infestation with 4.6% and in liver, respectively – with 4.3 %, 7.3% and 14.7%.

In cattle with low intensity of infestation the fat content in meat decreased with 24.24%, average - 30.3% and high - with 42.42%, in liver, respectively - with 22.73%, 27.27% and 50.0%.

Table 8. The chemical composition of the meat and liver of the infested with echinococosis cattle

Study sample	Intensity of invasion	Humidity	Dry substance	Proteins	Lipids	Mineral substances
Muscular tissue	Healthy	73,8±0,1	26,2±0,06	21,7±0,2	3,3±0,06	1,2±0,06
	Low	75,1±0,06	24,9±0,1	21,6±0,06	2,5±0,12	1,2±0,1
	Medium	75,4±0,12	24,6±0,06	20,9±0,06	2,3±0,06	1,0±0,1
	High	76,3±0,15	23,6±0,15	20,7±0,12	1,9±0,1	1,0±0,06
Liver	Healthy	69,8±0,1	30,2±0,2	23,2±0,12	4,4±0,23	1,4±0,12
	Low	70,3±0,15	29,7±0,2	22,2±0,1	3,4±0,1	1,2±0,1
	Medium	72,9±0,1	27,1±0,15	21,5±0,06	3,2±0,17	1,2±0,06
	High	75,9±0,1	25,1±0,1	19,8±0,15	2,2±0,1	1,1±0,06

In cattle with low intensity of infestation the quantity of mineral substances in the meat wasn't reduced, and in those with medium and high intensity of infestation was reduced with 16.7%. In the liver in cattle with low and medium intensity of infestation it decreased with 14.3% and those with high intensity - with 21.4%.

Thus, the results of parasitological studies after the slaughtering the animals in slaughter houses prove that the echinococcosis in cattle of different age and as of different maintenance technologies is frequently recorded and reveal the irregular conducting of dehelmintization and in some farms – its total absence. In infected animals it provokes significant decrease in gaining daily weight, modification in chemical composition, vitamins, micro- and macroelements in meat and comestible by-products and reduces their nutrition value. Thence, it is necessary to improve the system of evaluation of animal status, meat and comestible by-products originated from the infested animals.

Conclusions

1. It was established a high level of infestation of cattle with echinococcus, across geographical zone of growth and maintenance of their technology, constituting 79.2% of cases in adult bovine and 34.3% in young cattle (23-25 months).

2. The high level of infestation with echinococcus is possible, probably due to continuous contact with the definitive host and lack of dehelmintization or its irregular conducting.

3. In cattle infected with echinococcus there are changed the content of vitamins (A, E, B1, B2, C), micro- and macro-elements (Ca, Mg, Na, K, Fe, P) and chemical indices (moisture, dry matter, protein, lipids, minerals) in muscle tissue and liver that negative affects considerably the nutritional value.

4. When processing the meat and edible by-products is necessary to consider the intensity of cattle infestation with echinococcus. The meat and edible by-products without echinococcus should be used depending on nutritional value: at low infestation – without restriction, at medium infestation – only industrial processing (manufacture of sausages, canning etc.), high infestation - industrial processing only after bacteriological research.

5. Payment to economic agents in the realization of live animals, carcasses and edible by-products, to be carried out depending on the level of infestation with parasitic agents.

Acknowledgements

The present work was performed within the project 15.817.02.12F financed by Academy of Sciences of Moldova.

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