

EFFECTS OF ECHINOCOCCOSIS ON ANIMAL MEAT

Odil Achilov^{1*}, *Khudaynazar Yunusov*², *Abdusamat Sultankulov*³

^{1,2,3} *Samarkand state university of veterinary medicine, livestock and biotechnologies, Samarkand, Uzbekistan*

**Corresponding email: odiljon.achilov@mail.ru*

ABSTRACT

Assortment of finished products of meat is quite large in the food market of Uzbekistan, but these products quality are varying. Today quality control of meat and meat products is very important in slaughterhouses in terms of safety. The conducted studies of the meat of healthy and echinococcosis animals allow us to conclude that this disease has some influence on some parameters that determine the quality of meat. According to a study of 1,678 cattle slaughtered in slaughterhouses in the Samarkand region of Uzbekistan, the average incidence of echinococcosis was 8.6%. In terms of organoleptic parameters, the meat of healthy animals does not differ from the meat of animals suffering from echinococcosis. Echinococcosis leads to a decrease in the nutritional value of meat, which is expressed by low levels of protein and fat. This indicates that during invasion by echinococcosis in the studied tissues and organs, the pH indicator shifts towards an alkaline reaction due to the primary decay of the protein. The high moisture content in the meat of animals with echinococcosis is an unfavorable factor affecting the resistance of meat to long-term storage.

KEYWORDS: *Echinococcus, safety, quality, cattle, beef, muscle, slaughterhouse, veterinary sanitary examination, Uzbekistan.*

INTRODUCTION

Providing the population with food and healthy nutrition is an important and urgent task of national importance. Social stability of society and health of the population is impossible without its solution. In recent years, in connection with the change in the nature of the domestic market, measures have been taken to integrate the Uzbek economy into the world one. When solving this important state task, the requirements of environmental and sanitary control imposed on Uzbekistan by the member countries of the World Trade Organization are taken into account.

The concept of healthy nutrition of the population and the state policy for creating the foundations of biological safety in our country involve the modification of the legislative framework and regulatory and methodological support of state supervision over the quality of animal products, the harmonization of which with international standards is an urgent area of veterinary sanitary examination and food safety of Uzbekistan [1,2,22].

In this connection, it is necessary to constantly improve and test modern scientific achievements and carry out systematic control aimed at preventing substandard products from entering the sale, in case of animal helminthiasis, in order to eliminate harmful effects on human health [11,13].

Echinococcosis - are chronic helminthiasis characterized by destructive lesions of the liver, lungs and other organs, allergization of the body and severe complications, often leading to disability and death. [6,17,18]. It is a new disease in many parts of the world, especially in the countries of the former Soviet Union, Eastern Europe and Asia [21,23].

There are difficulties in early diagnosis, surgical interventions are carried out in advanced stages, there are certain difficulties in carrying out comprehensive preventive measures that are associated with serious economic problems [4].

WHO and the International Bureau of Epizootic have included echinococcosis in the list of diseases subject to radical eradication [3,14]. In a number of countries (New Zealand, Argentina, Greece, Turkey, Spain, Italy, etc.), for which echinococcosis is a marginal pathology, its elimination has been raised to the rank of a state task, special national programs are being developed to control and prevent the disease. Thanks to such programs, in a number of countries previously unfavorable for echinococcosis (Iceland, Norway, Australia, and Tasmania), the disease has practically been eradicated [24]. Echinococcosis not only harms the health of animals and humans, but also causes economic damage, and therefore continues to be an important public problem [5,7,8,9,10,].

Thus, given that animal husbandry is a traditional branch of agriculture, and meat products constitute a significant proportion of the population's diet, research and development of scientifically grounded criteria for assessing the quality and safety of cattle slaughter products in case of echinococcosis in Uzbekistan remains a problem, the relevance of which is beyond doubt, which determined the purpose of these studies.

The aim of the study was to determine the quality and safety of meat and meat products from cattle infected with echinococcosis.

MATERIALS AND METHODS

Study area and animals

The study was conducted from February 2020 to January 2021 in the slaughterhouses in Samarkand region, Uzbekistan. A total of 1,678 slaughtered cattle in age of 2 to 5 years were observed.

Post mortem examination

The veterinary examination was carried out following the requirements established in Chapter I Domestic bovine animals (Bovine animals over six weeks old) of Section IV of Annex I Regulation (EC) No 853/2004 of the European Parliament

and of the Council of 29 April 2004 laying down specific rules for the organization of official controls on products of animal origin intended for human consumption.

In the process of post-mortem veterinary and sanitary examination, echinococcal blisters of various sizes were found in the liver and lungs, the affected organs had a hard consistency and a bumpy surface.

A portion of approximately 200g of *Longissimus dorsi* muscle from 7 clinical healthy and from 3 animals with signs of echinococcus invasion was collected and stored hermetically in closed and labeled containers and frozen to -5°C until chemical analyzing (not more than 3 days).



Figura 1. The region where the research was conducted.

Healthy and echinococcosis-infected cattle were carried out in accordance with the rules of veterinary-sanitary examination in determining the physicochemical parameters of meat and meat products (volatile fatty acid content, amino-ammonia nitrogen content, reaction with nessler reagent, formalin reaction and pH) [20].

Organoleptic methods of sampling and determination of purity were tested in accordance with the international standard of meat and meat products «GOST 34567-2019» [15].

The purity, chemical and microscopic analysis of meat was carried out in accordance with the standard «GOST 23392-78» [16].

Data analysis

Basic data entry and handling were done using MS Excel (2010). The significance of differences among chemical values of each sample was determined by analysis of variance (ANOVA) and t-test. Prevalence of echinococcosis was calculated as the number of cattle found infected with echinococcus expressed as the percentage

of the total number of slaughtered. Differences were considered significant at $p < 0.05$ level.

RESULTS

Post mortem examination

In the process of post-mortem veterinary and sanitary examination, echinococcal blisters of various sizes were found in the liver and lungs, the affected organs had a hard consistency and a bumpy surface. The condition of patients with echinococcosis and healthy animals was average.

At postmortem examination, a visual inspection was made of the condition of the carcass, the head and regional lymph nodes. In carcasses of healthy animals the muscles were well developed, thoracic and lumbar vertebrae, hips were allocated not sharply; the neck, scapula's, forward ribs and legs, the pelvic cavity and area of a groin had fat deposits in the form of small sites. In terms of organoleptic indicators, the meat of sick animals did not differ from that of healthy animals: the carcasses of the animals had a dark red color, with a specific smell, dense consistency; the cut surface was moderately moist.

In carcasses of animals, infected by echinococcosis, there were less developed muscles, prominent spinous processes of vertebrae; a poor development of the fatty layer was noted.

During the study, from 1678 cattle obtained from the slaughterhouse, 145 (8.6%) animals were positive for echinococcosis. Contamination by echinococcosis of cattle had rather stable character and slightly varied depending on a season of slaughter of cattle (Table 1).

Table 1. Dynamics of echinococcosis infection of cattle on seasons of year (2020)

Seasons	Number of cattle		Prevalance %
	Investigated	Infected	
Spring	413	34	8,2
Summer	406	32	7,9
Autumn	423	37	8,7
Winter	436	42	9,6
Total	1,678	145	8,6

In the spring the contamination of sheep was, on the average, 8.2%. The infection prevalence was rather high during the winter period and reached 9.6%. In the summer and autumn the prevalence was lower, 7.9% and 8.7%. The average level of contamination of cattle was 8.6%.

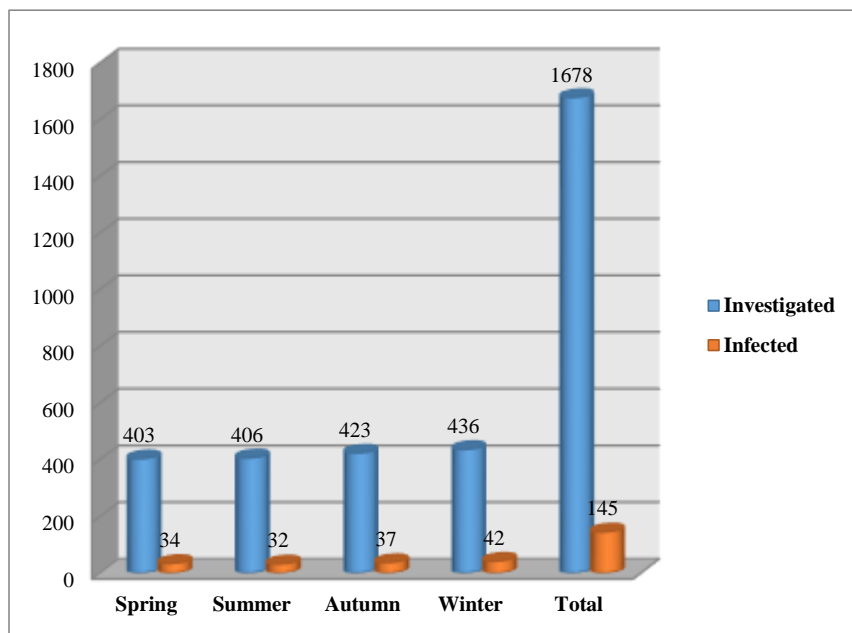


Figura 1. Dynamics of echinococcosis infection of cattle on seasons of year (2020)

Infection of the internal organs of cattle with echinococcosis indicates that in most cattle only 52.4% had liver damage. Simultaneous damage to the liver and lungs was 46.2%. The kidneys, liver, and lungs of cattle were simultaneously damaged by 1.4% (Table 2).

Table 2. Distribution of echinococcus cysts on organs of the infected cattle (n = 193)

Organs	Distribution of echinococcus	
	Number of animals	%
Liver	76	52,4
Liver, lungs	67	46,2
Kidneys, liver, lungs	2	1,4

Physicochemical examinations

After the animals are slaughtered, the meat obtained undergoes complex biochemical processes, i.e. the meat is cooked, the hardness changes, the moisture and the smell change. Therefore, it is important to compare the physicochemical parameters of the results of laboratory tests in the veterinary and sanitary examination and assessment of the quality of meat from sick and healthy animals.

The examined beef samples were reddish in color when viewed in natural light, weakly moistened on a well-blooded cut surface, and no traces of moisture remained on the surface of the filter paper. The consistency of the meat is firm, the puddle formed

when the surface of the meat is pressed with a finger quickly returned to its original position. The cut surface of the meat is clean, not sticky, has a characteristic odor of beef.

Physicochemical parameters of beef infected with echinococcosis and clinically healthy cattle are presented in the results of standard studies (Table 3).

In the meat of cattle from healthy carcasses, the amount of volatile fatty acids was 3.6 ± 0.02 mg, while in the sample from echinococcus-infested carcasses, the amount of volatile fatty acids reached 4.5 ± 0.03 mg /%, which indicates a doubtful freshness of meat.

The content of amino-ammonia nitrogen in meat from healthy cattle was 1.25 ± 0.2 mg, and from cattle infested with echinococci it was higher and reached 1.29 ± 0.3 mg.

Table 3. Change in physicochemical parameters of cattle meat in echinococcosis

Animal groups	Physicochemical indicators of meat				
	the amount of volatile fatty acids (mg /%)	amino ammonia nitrogen (mg)	reaction with Nessler's reagent	formalin test	pH
Control	$3,6 \pm 0,02$	$1,25 \pm 0,2$	pale yellow, clear	clear, the reaction is negative	$5,81 \pm 0,2$
Experienced	$4,5 \pm 0,03$	$1,29 \pm 0,3$	yellow, noticeably fuzzy	partially blurred, the reaction is positive	$6,21 \pm 0,1$

Nessler's reaction with a sample of meat from animals from the experimental group showed a turbidity and yellow tint of the filtrate, while in the group of healthy cattle it was pale yellow, transparent in color. When examining beef infected with echinococcosis, a positive result was noted in the formalin reaction, partial turbidity was observed in the broth, while in healthy beef the reaction was negative, the broth was liquid and clear.

The concentration of hydrogen ions (pH of meat) in the meat of animals in the control group 1 hour after slaughter was 6,2-6,3, experimental – 6,3-6,4. One day after slaughter, the pH of the meat of healthy animals was 5,81-5,92. In the first hours of

autolysis, glycolytic processes predominate, leading to the accumulation of lactic acid, as a result of which the pH value of the muscle tissue decreases.

Immediately after the slaughter of the animal, before the onset of pronounced post-mortem changes, the meat has an elastic consistency, pink-red color and has a high moisture-binding capacity, but its aroma is weak. Termination of animal life is a triggering mechanism in the development of post-mortem changes, the nature and depth of which determines the qualitative characteristics of muscle tissue, its physicochemical properties and directly affects the functional and technological parameters of raw meat. Due to the breakdown of glycogen and the accumulation of lactic - phosphoric acids (as a result of dephosphorylating of intermediate products of glycolysis: glucose phosphates, and subsequently, creating phosphate and nucleotides), the reaction of the muscle tissue environment shifts to the acidic side. Such a shift in the indicator to the acidic side indicates a high activity of glycolytic enzymes, which contributes to the normal course of the maturation of meat and its long-term storage. In sick animals, the concentration of hydrogen ions after 1 day was on average $6,21 \pm 0,01$, which indicates violations of glycolysis processes, which ultimately affects the digestibility and assimilability of such meat (see Table 3).

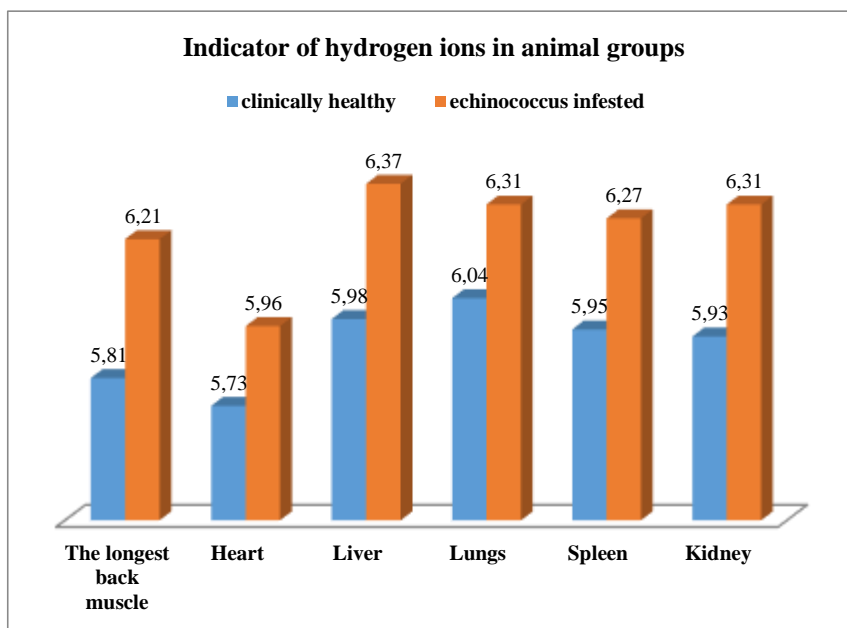
Taking into account the role in the objective assessment of the quality of slaughter products, studies of the concentration of hydrogen ions in organs and tissues were carried out in both clinically healthy and echinococcosis-infected cattle. At the same time, it was found that in the meat and internal organs (heart, liver, lungs, spleen and kidney) of animals infected with echinococcosis, the pH value significantly increases, compared with clinically healthy cattle.

This indicates that during invasion by echinococcosis in the studied tissues and organs, the pH indicator shifts towards an alkaline reaction due to the primary decay of the protein.

Table 4. The influence of echinococcosis on the dynamics of the pH of meat and internal organs of cattle

Name of the examined organs	Indicator of hydrogen ions in animal groups	
	clinically healthy (n=15)	echinococcus infested (n=15)
The longest back muscle	$5,81 \pm 0,02$	$6,21 \pm 0,01$
Heart	$5,73 \pm 0,01$	$5,96 \pm 0,03$
Liver	$5,98 \pm 0,03$	$6,37 \pm 0,01$
Lungs	$6,04 \pm 0,02$	$6,31 \pm 0,03$
Spleen	$5,95 \pm 0,04$	$6,27 \pm 0,03$
Kidney	$5,93 \pm 0,03$	$6,31 \pm 0,05$

As a result of studies of hydrogen ions in meat and internal organs of cattle, it was established that in clinically healthy and echinococcus-infested animals, the pH value of meat and internal organs has different meanings. In infected animals, the pH value was higher in all tissue samples examined (table 4 and figura 2).



Fifura 2. The influence of echinococcosis on the dynamics of the pH of meat and internal organs of cattle

Biochemical properties of muscle tissue in cattle

As a result of the study, it was found that in cattle infected with echinococcus, the moisture content in the muscle tissue is higher than in healthy animals and is 68.7 ± 0.50 and 64.7 ± 0.10 g /100g, respectively. This demonstrates an increase in muscle hydration. Protein concentration in healthy animals was 10% higher than in infected animals. The content of fat in muscles in sick cattle was significantly lower, and amounted to 40% of the value in healthy livestock. The energy value of beef also depended on the presence of infestation in animals and was lower in sick cattle by approximately 24-28 calories per 100g of sample. Infection with echinococcus also causes significant changes in mineral metabolism: the content of the investigated macro and microelements decreases (table 5).

Table 5. Nutritional value of beef

Indicators	Meat of animals	
	Infected by echinococcosis	Healthy
Nutrition value (g/100 g)		

Proteins	19,13±0,26	22,1±0,53
Fats	9,3±0,09	15,3±0,04
Moisture content	68,7±0,50	64,7±0,10
Ashes	1,1±0,09	0,9±0,03
Calorific value cal/100 g	161±1,14	189±1,45
Vitamins (mg/100 g)		
Vitamin A	0,006±0,01	0,016±0,01
Vitamin E	0,6±0,02	0,8±0,22
Vitamin PP	4,45±0,04	4,5±0,22
Vitamin B ₁	0,4±0,10	0,5±0,23
Vitamin B ₂	0,14±0,01	0,2±0,19
Mineral elements (mg/100 g)		
Potassium (K)	341,0±0,37	355,0±2,53
Calcium (Ca)	9,2±0,05	11,2±0,19
Magnesium (Mg)	20,7±0,07	25,0 ±0,95
Sodium (Na)	68,9±0,10	71,4 ±0,93
Iron (Fe)	2639,0±1,06	2908,0±1,23
Zinc (Zn)	2958,0±0,71	3246,0±1,92

According to our data, in the meat of cattle infected with echinococcus, the calcium content was 9.2±0.05 mg /100g and was 17.8% less than in healthy animals; magnesium - 20.7±0.07 mg / 100g and 11.2%; sodium - 68.9±0.10 mg / 100g and 3.6%; potassium 341.0± 0.37 mg /100g and 3.1%, respectively.

A similar picture was observed with respect to the trace elements Fe and Zn, the difference in the percentage of the concentration of which in infected and uninfected animals was 9.3 and 8.9%, respectively (table 5).

The research results show that echinococcosis has a significant effect on the quantitative indicators of the vitamin composition of the muscle tissue of cattle. The content of all water and fat-soluble vitamins in the meat of infected animals was lower than in healthy animals. In particular, the concentration of vitamin A was in the range of 0.006 ± 0.01 mg / 100g and was 63% lower than that of non-invested cattle; vitamin E-0.6 ± 0.02mg / 100g and 25%; vitamin B₁ - 0.4 ± 0.10 mg / 100 g by 20%; vitamin B₂ - 0.14 ± 0.01mg / 100g by 30%; vitamin PP -4.45 ± 0.04mg / 100g by 1.2%, respectively.

DISCUSSION

Our research demonstrated that the average contamination of *E. granulosus* of slaughtered cattle aged 2 to 5 sold through the market in the Samarkand region of Uzbekistan is 8.6%. The incidence of *E. granulosus* infection in adult cattle did not display large fluctuations on seasons of the year. In our opinion, this is explained by the constant character of the invasion by oncospheres during the life time of the cattle. Accordingly, the lowest prevalence of infection of cattle established during autumn and winter seasons of year. Intensity of an invasion by fertile echinococcus larvae varies within 3 to 4 cysts on the organ. Parasites are mainly found in liver and lungs (in 98.6% of animals). In other isolated cases there were observed multiple echinococcoses with simultaneous infection of kidneys or spleens.

Thus, it has been established that with the invasion of echinococcosis in meat of cattle, organoleptic and physicochemical properties significantly decrease, the pH value in the tissues of the invaded animals shifts towards an alkaline reaction, and quantitative indicators of nutritional value, mineral elements and vitamins, and essential fatty acids decrease.

Studies of the chemical composition of meat and meat products of sheep infected with echinococcosis established that the maintenance of protein and fat decreases, and moisture increases (Z.Valieva et al.,) [26].

The results of the current study have shown that nutrient composition, fatty acid profile, levels of amino acids, vitamins and mineral elements in meat from healthy animals differ in results obtained from various regions of the world (Levies et al., 1995; Brzostowski et al., 2004) [19,12]. Williams (2007) indicated that nutritional composition of beef depends on breed of cattle, feed, season and cut of meat [25].

The biochemical analysis also showed that in the beef from cattle infected by hydatidosis, in comparison with muscle tissue of healthy animals, the amount of protein, fat and calcium, calorific value significantly decrease. Besides, in the meat of animals infected with echinococcosis there is a substantial increase of humidity and amount of ashes.

The results of the conducted studies allow us to conclude that biochemical changes in the meat of invaded animals are the reason for a decrease in its biological and nutritional value.

CONCLUSION

Studies on the meat of healthy and echinococcosis-infected cattle have led to the conclusion that it affects some parameters that determine meat quality. According to organoleptic tests, the meat of healthy animals is no different from the meat of animals infected with echinococcosis. The physicochemical changes shown in the muscle tissue of infected cattle led to a decrease in the biological value of the meat.

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