

## MEAT'S PHYSIC-CHEMICAL PROPERTIES IN SHEEP INFECTED WITH ECHINOCOCCOSIS

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Samples of *Longissimus dorsi* muscle, liver, lung, heart, kidney and spleen collected in the Almaty slaughter house from 5 clinical healthy and from 5 sheep with signs of echinococcosis were investigated in the Laboratory of Veterinary Sanitary Expertise of Animal Origin Products and Row of the Kazakh National Agrarian University following the requirements established in specific rules for the organization of official controls on products of animal origin. There were shown changes in the properties of meat as a result of sheep echinococcosis: increased content of volatile fatty acids, amino-ammonia nitrogen. In the boiling test the broth of meat from infected sheep was cloudy, with less fat. Meat of sheep infected with *Echinococcus* larvae gave a negative reaction to the peroxidase and formalin reaction. In meat and internal organs of animals with echinococcosis was indicated a shift in the pH value towards the alkaline reaction. The optical density of muscles and internal organs of uninfected animals was lower by 20%, in the liver - 36%, in the lung tissue - 32% and in the tissues of the spleen - 21% compared with the same organs of infected sheep. Results demonstrated the presence of foreign substances in meat and evidence of biological value deterioration of the meat due to the biochemical processes associated with animals' infection by echinococcosis.

Key words: Echinococcosis, Sheep, Meat quality.

## ФИЗИКО-ХИМИЧЕСКИЕ СВОЙСТВА МЯСА ОВЕЦ ПРИ ЭХИНОКОККОЗЕ

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Образцы длиннейшей мышцы спины, печени, легких, сердца, почек и селезенки от 5 клинически здоровых и от 5 зараженных эхинококками овец, собранные в Алматинском убойном пункте, были исследованы в Лаборатории ветеринарно-санитарной экспертизы продуктов животного происхождения и сырья Казахского национального аграрного университета. Было установлено изменение свойств мяса овец, зараженных эхинококкозом: увеличение содержания летучих жирных кислот, amino-аммиачного азота. Бульон мяса зараженных овец был мутноватым, с меньшим количеством жира. Мясо овец с эхинококкозом дало негативную реакцию на пероксидазу и реакцию с формалином. В мясе и внутренних органах животных с эхинококкозом был выявлен сдвиг pH в сторону щелочной реакции в связи с распадом первичного белка. Оптическая плотность мышц здоровых животных была ниже на 20%, печени - на 36%, легочной ткани - на 32%, а селезенки - на 21% по сравнению с органами инфицированных овец. Результаты исследований показали ухудшение биологической ценности мяса из-за биохимических процессов, связанных с эхинококкозом животных.

Ключевые слова: эхинококкоз, овцы, ветеринарно-санитарная экспертиза.

## ЭХИНОКОККОЗ КЕЗІНДЕГІ ҚОЙ ЕТІНІҢ ФИЗИКАЛЫҚ-ХИМИЯЛЫҚ ҚАСИЕТТЕРІ

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Алматы қасапханасында 5 клиникалық сау, 5 эхинококкозбен заладанған қойлардан жинақталған арқаның ең ұзын бұлшықеті, бауыр, өкпе, жүрек, бүйрек және көкбауыр сынамалары Қазақ Ұлттық Аграрлық Университетінің Жануартектес өнімдер және шикізатты ветеринариялық санитариялық сараптау зертханасында зерттелді. Эхинококкозбен залалданған қой етінде төмендегі ауытқулар: ұшынды май қышқылдары, amino-аммиакты азоттың өсуі, ет

сорпасының тұнықтығы және май мөлшері төмендеуі анықталды. Мұндай ет пероксидаза мен формалинге теріс реакция берді. Эхинококкозы бар қойлардың еті мен ішкі органдарындағы бастапқы ақуыздың ыдырауына байланысты рН сілті реакция бағытына ауысты. Залалданған қойлармен салыстырғанда сау жануарлардың бұлшық етінің оптикалық тығыздығы 20%, бауырдың - 36%, өкпе ұлпасының - 32%, көк бауырдың - 21% төмен болды. Зерттеу нәтижелері еттің биологиялық құндылығының мал эхинококкозы кезінде жүретін биохимиялық процестерге байланысты төмендейтінін көрсетті.

Негізгі ұғымдар: эхинококкоз, қой, ветеринариялық-санитариялық сараптау.

## Introduction

Cystic echinococcosis (CE) is an important zoonotic infection which has a high morbidity and mortality in humans and huge losses in livestock breeding [1]. Echinococcosis is distributed over the world, especially in countries with nomadic animal breeding traditions in Europe, Asia and Africa [2, 3]. It is known that at last three decades there was observed a considerable increase of indices of CE in Kazakhstan [4, 5, 6]. But research of sanitary assessment of meat and other products from animals with echinococcosis was not practically carried out. It is known that parasites have an impact at meat and wool productivity and quality [7, 8]. Biochemical methods are shown that beef from cattle with echinococcosis is lower quality than the meat from healthy animals [9, 10].

Taking into the account that sheep breeding is a traditional branch of animal husbandry and the mutton produced makes a significant share of a meat diet of the population in Kazakhstan, the purpose of this research has been to define the influence of the infection by echinococcosis on the quality of the tissues of slaughtered sheep.

## Material and methods

Research was carried out in the Almaty regional slaughter house and the Laboratory of Veterinary-Sanitary Expertise of Animal Origin Products and Row of the Veterinary Faculty of the Kazakh National Agrarian University following the requirements established in specific rules for the organization of official controls on products of animal origin intended for human consumption.

During post-mortem examination, organs of the abdominal and thoracic cavities namely liver, lung, kidney and spleen were systematically inspected for the presence of *Echinococcus granulosus* cysts by applying the routine meat inspection procedures. Diagnosis of *E.granulosus* cysts was done macroscopically either by visual inspection or palpation and, where necessary, one or more incisions were made in order to detect small hydatid cysts. The condition of the liver, lungs and other internal organs, as well as the carcass was sensory assessed. The degree of bloodless, appearance, color, texture, smell, and the fat status of meat were determined.

A portion of Longissimus dorsi muscle, liver, lung, heart, kidney and spleen (approximately 200 g of each sample organ) from 5 clinical healthy and from 5 animals with signs of echinococcosis was collected and stored hermetically in closed and labelled containers and frozen to  $-10^{\circ}\text{C}$  until analyzing (not more than 5 days). Odour of meat was first determined at the surface, and then in the deep muscular tissue. For a more accurate assessment of the smell of the meat sample was put the boiling test. Consistency of the meat was determined by the rate of recovery of a fossa after pressure on the surface of the meat by finger.

Parameters of meat and internal organs as organoleptic characteristics (appearance, color, texture, smell); physic-chemical parameters (sample digestion, reaction to the peroxidase, reaction with copper sulphate, the determination of amino-ammonia nitrogen (by Sofronov), formalin reaction, Nessler reaction were investigated in both control and experimental groups of animals. The meat and inner organs both the control and the experimental groups of animals were examined the hydrogen ion concentration (pH) and the optical density of the samples by the conventional methods. The hydrogen ion concentration was determined by the pH-meter pH-150MI. The optical density was measured at KFK.

For entering and analyzing the basic data was used M-EXCEL. The significance of differences in chemical values of each sample was determined by analysis of variance. Differences were considered significant if  $p < 0,05$ .

## Results

Under natural light samples of meat from the study groups of sheep were red, good bloodless, the cut had a slight degree of moisture on the filter paper and did not leave a wet track. The meat was elastic consistency, the fossa formed when pressed with the finger, leveling quickly. The muscle cut's surface was pure, not sticky at the touch, and the meat had a drying crust and peculiar to mutton smell.

Carcass surface fat from healthy and infested by echinococcosis sheep was white, firm consistency, lightly crush crumble. Tendons of carcasses from experimental and control groups of animals were resilient and dense, surfaces of joints were smooth and shiny.

Aqueous extracts of meat from uninfected and infested echinococcosis animals filtered same. However a meat filtrate of healthy animals was more transparent than the meat filtrate from infected sheep.

The results of standard testing of meat showed a slight change in the physic-chemical parameters in the meat from infected by echinococcosis sheep. In particular, in the reaction with 5% copper sulfate in a

meat broth of infected sheep was observed hardly detectable turbidity, while the meat broth of healthy animals was transparent and free of impurities (Table 1).

In meat from clinically healthy animals volatile organic acids were accordingly to the norm. In the samples of meat from sheep with echinococcosis amount of volatile fatty acids increased insignificantly.

**Table 1 - Change of meat physic-chemical parameters of infected by echinococcosis sheep**

Group of sheep	Meat physic-chemical parameters							
	reaction with copper sulphate	amount of volatile fatty acids (mg%)	amino ammoniacal nitrogen (mg%)	boiling test	reaction to the peroxidase	test for formalin	Nessler reaction	pH
Control*	transparent, without impurities	2,1±0,03	1,21±0,03	aromatic, clear broth, surface fat droplets	+	clear broth, negative reaction	pale yellow, transparent	5,7±0,03
Experimental**	slightly noticeable turbidity	2,8±0,05	1,34±0,05	cloudy broth, less fat amount	-	clear broth, negative reaction	turbidity with yellow tint	6,4±0,01
*- healthy animals **- animals with echinococcosis								

Hydrogen sulphide was not detected in all samples. The amino ammoniacal nitrogen content of meat from clinically healthy sheep is in the normal range, while in the experimental group the content of the indicator increased about 10%. Meat from healthy sheep in the boiling test gave an aromatic, clear broth, fat droplets were collected on the surface, while the broth from the meat of infected animals was unclear, and the amount of fat was significantly less.

The reaction to peroxidase on meat from the control group was typical for fresh meat, what indicates the presence of the peroxidase enzyme. In the experimental group reaction to the peroxidase was negative.

Formalin reaction showed that the broth and meat from clinically healthy and infected sheep was transparent, the reaction is negative.

In Nessler reaction meat from uninfected sheep showed a pale yellow, transparent color, and in samples from the experimental group were observed turbidity and a yellow tint (Table 1).

Meat quality, its suitability for consumption and maturation depend on the accumulated hydrogen ions. The concentration of hydrogen ions is important as an indicator of the internal environment. In various pathologies there is a shift in the pH value to the acidic or alkaline condition. When a deviation from the optimum values of hydrogen ions the enzyme activity is significantly reduced or even completely terminated, that ultimately leads to death of the organism.

The meat obtained from clinically normal sheep had a pH averaging, 5,7±0,03; pH of meat obtained from infested animals ranged 6,4 ± 0,01 (Tables 1,2). However, studies have shown that free from invasion and infected sheep echinococcosis pH muscles and internal organs differ in magnitude. Moreover, this figure in infested animals was higher in all examined tissues (Table 2). There was established that in meat and internal organs (liver, lung and spleen) of animals with echinococcosis, the pH value increases significantly, compared to clinically healthy animals (Table 2). This indicates that when cystic echinococcosis developed in tissues of examined organs there was a shift in the pH value towards the alkaline reaction due to the collapse of the primary protein.

**Table 2 - Effect of pH on the dynamics of echinococcosis meat and internal organs**

Organ	pH in the groups of animals	
	clinically healthy	infested with Echinococcosis
M.longissimus	5,7±0,03	6,4±0,01*
liver	5,58±0,05	6,17±0,06*
lungs	5,52±0,03	5,67±0,02*
spleen	5,66±0,02	5,96±0,01*
* p < 0,05		

So in clinically healthy and infested with echinococcosis sheep pH value of meat and internal organs had shown a different meaning. Infested sheep pH value was higher in all investigated tissue samples. In particular, the long back muscles pH value was more than 13% in the liver - 10%, in the lung tissue - by 3% and in the tissues of the spleen - by 6% compared with samples from healthy animals.

Research had shown that free from infestation and echinococcosis infected sheep the optical density muscles and internal organs differs in magnitude (Table 3).

Moreover, this indicator of all examined tissues from infected animals was higher than healthy sheep. In particular, the long back muscle's optical density of uninfected animals was lower by 20%, in the liver –

**Table 3 - Effect of echinococcosis on the dynamics of change in the optical density of the meat and internal organs of sheep and goats**

Organ	Optical density of animals	
	clinically healthy	infested with Echinococcus
M.longissimus	0,52±0,01	0,65±0,02*
liver	0,63±0,01	0,98±0,01*
lungs	0,47±0,02	0,69±0,01*
spleen	0,58±0,01	0,73±0,01*

\* p < 0,05

36%, in the lung tissue - 32% and in the tissues of the spleen - 21% compared with the same organs of infected sheep.

### Discussion

It is known that echinococcosis has a significant impact on the physical and chemical characteristics and quality of products of slaughter of infected animals [9,11]. This information is confirmed by results of current research. Although the organoleptic characteristics of meat, surface fat, tendons were within normal limits, there were established changes in the properties of meat as a result of sheep echinococcosis: increased content of volatile fatty acids, amino-ammonia nitrogen. In the boiling test the broth of meat from infected sheep was cloudy, with less fat. Meat of sheep infected with Echinococcus larvae gave a negative reaction to the peroxidase and Formalin reaction.

It should be noted that the hydrogen ions occupy a special position in various biological processes. The concentration of hydrogen ions is one of the most important constants of the internal environment of the body, while the activity of various enzymes, as well as the specifics of place in the tissues of biochemical processes are closely linked to specific, rather narrow intervals of hydrogen ions [12].

The pH of meat depends on the carbohydrate content at the moment of slaughter of the animal, an intramuscular enzyme activity and antermortem condition of the animal. pH of the alive animal's muscle tissue is slightly alkaline. After slaughter during the fermentation of healthy animals' meat pH has a sharp shift to the acidic reaction [9,11]. Taking into account the role of the pH in the objective evaluation of the quality of slaughter products, there were studied values of the hydrogen ion concentration in organs and tissues as in clinically healthy and sheep infected echinococcosis.

Research results confirm the literature data, according to which at echinococcosis animals such a shift occurs regardless of the echinococcosis intensity. It is assumed that in this case there is a breakdown of proteins primary tissues of the infected organism. In the process of life Echinococcus granulosus produces toxins proteins promotes the formation of toxic and causes toxicity and allergic reactions of the affected organ as well as a host organism as a whole. Thus, clinically healthy animals pH value was in the normal range, indicating that the purity of meat. At the same time, there are differences in the pH value of different organs and tissues, which appear to be associated with the functioning of the bodies in the animal's life. Shift of the pH value in the alkaline side in the tissues of infected with echinococcosis animals indicates pathological process caused by parasites. It was established that in clinically healthy animals optical density in the extract of tissue and muscle were lower than echinococcosis. At the same time, there are differences in the optical density of different organs and tissues, which appear related to their functional characteristics.

This research have also shown that in clinically healthy and infested sheep optical density of muscles and internal organs had different meanings, which is associated with structural features, as well as the specificity of biochemical processes in the studied sites. Moreover, this figure in infested animals was higher in all tissues examined. So, the sheep in the long back muscles optical density was 20% higher in the liver - 36%, in the lung tissue - 32% in the spleen - 21%, respectively, compared with their counterparts uninfected animals.

Thus, these data suggest that the increase in optical density in the tissue extract of meat and internal organs can serve as a reliable criterion for assessing animal health products of slaughter animals with hydatid cyst. Extracts high optical density in the body infested sheep are formed due to the release of toxic proteins of *Echinococcus granulosus* cysts.

### Conclusion

Results of this research had shown an increase in the amount of volatile fatty acids, pH and change of other quality indices of meat from sheep infested with echinococcosis that demonstrates the presence of foreign substances in meat and evidence of deterioration or damage to the biological value of the meat due to the biochemical processes associated with animals' infection.

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