S U M M A R Y

of the titled doctoral thesis

THE INFLUENCE OF CLIMATE CHANGES ON THE PRODUCTION AND METABOLISM OF SHEEP IN THE SOUTHERN ECOZONE ALONG THE DANUBE, OF DOLJ COUNTY

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Small ruminants participate in the conservation of the biodiversity of many habitats and have a vital socio- and bio-economic function due to their ability to transform some poor food sources (roughage etc.) into protein (milk and meat) being much more efficient than other farm animals and especially, through their ability to maintain and continue their production even in constantly changing climatic conditions. Climate change is one of the most serious risks to the world today, to its population and economy. Climate change is a greater threat than at any time prior to the last millennium. We propose to address this current theme of the influence of climate change on sheep, conducting research on sheep raised on small holdings in an area of Romania where, normally during the summer, there are increased environmental temperatures that induce a felt discomfort (for example of people at an ITH of over 80 units), up to phenomena of severe or extremely severe thermal stress on all living things.

The structure of the doctoral thesis. In accordance with the rigors of the legal provisions, this paper is structured in 2 parts: a bibliographic study part and a part of personal research, including a rich iconography composed of 76 tables and 68 figures.

Part I Bibliographic study contains 48 pages, and contains 3 chapters main ones aiming at an up-to-date presentation of climate change data impacting food safety and security, relationships between sheep welfare and food safety and nutritional-metabolic surveillance of production diseases in sheep.

Part II. Own research, includes 100 pages. This part is structured in 10 chapters, each chapter having introductory part, material and methods, results and discussion and partial conclusions. General conclusions and bibliography containing 212 titles.

Part I. Bibliographic study

Chapter I. Climate change with impact on food safety and security. Data on the effect of climate change on animal health are updated. Next comes data on Greenhouse Gases and Global Warming, then Global Climate Change, Data on Globalization and the Green Economy. A separate chapter is represented by the data on the globalized multipolar world, on resource depletion and environmental pollution and on caloric stress

Chapter II. Relationships between sheep welfare and food safety.. This chapter presents the main issues related to Farmers' Perception of welfare standards on sheep farms. Another chapter deals with Sheep Welfare Data and a chapter on the Influence of Climate Change on Pastoral Activity.

Chapter III. Nutritional-metabolic surveillance of production diseases in sheep. Data related to Animal Metabolic Profiling are updated, including optimal timing for metabolic profiling, another chapter on Metabolic Profiles or Panels, and a chapter on Interpretations of metabolic parameters in sheep.

Part II: Own research

Chapter IV. I referred to **the purpose and objectives** of the research

Chapter V. Material and methods. The research was carried out on period of 6 years (2017-2023), on 8 flocks of sheep from non-professional holdings within the radius of CSVSA Bârca Jud. Dolj, an important area in the south of Dolj county, having the shape of an equilateral triangle, Danube riparian ecozone. The cases studied differed from one holding to another, both in the cold period and in the warm period when unprecedented climatic maxima were recorded, ending in summer with heat stress in the animals. I collected important epidemiological data regarding the herds from the 8 researched holdings, I inquired about data related to the environment, soil, water, air and pasture condition, statistical bulletins and reports provided by CSVSA Bârba and the DSVSA Craiova laboratory.

In the areas where we carried out our research activity, we made a request for concrete data on all the links of the anthropic ecosystem, obtaining data on the main elements of the anthropic ecosystem, the air quality being strongly influenced by the proximity to the Koslodui Atomic Power Plant with effects directly on the main links: air-water-soil-plants-animals-food-man. I traveled to the sheep farms and carried out a proper anamnesis of the flocks, with statistical data about the flocks, nutritional data, calving situations and milk production in sheep, both in winter but especially in

summer, in the midst of climate change. The stage followed, the clinical examination of the animals, analysis of the ration and feed assortments, assessments of the soil-water-plant-animal-human relationship, therefore traceability, the metabolic profile examinations: biochemical and hematological and the interpretation of the results obtained through metabolic correlations.

Chapter VI. Metabolic status in sheep holdings M1 and M2. The research was carried out at 2 holdings in the Măceșu de Sus commune, in the years 2018-2019. We have analyzed and finalized the data on the status of the lactating Turcan sheep. From the M1 farm, after the anamnestic data and the clinical examination of the herd, we collected blood samples and requested the laboratory to perform hematological and blood biochemical examination.

In the M2 holding, according to the anamnestic and clinical data, we found a large number of sheep with internal and external parasitosis, a situation created by the lack of antiparasitic therapy. I also performed a necropsy examination where I noticed parasitic cysts in the liver and lung. Also here we took 5 blood samples from metis sheep and 5 blood samples from breeding rams for biochemical and hematological examination.

It was noticed that in the 2 holdings we followed, the conditions for growing, maintaining and exploiting sheep during the summer are totally inadequate. After the laboratory investigations, it was found that in the sheep from the M2 farm we can speak of a more complex pathogenetic picture, the existence of a possible hepato-biliary pathology in the Turcan sheep through the increase of GGT and total biblirubin; hematologically, there is a marked increase in the % of eosinophils, which indicates an intense internal parasitism that was probably not properly treated or the infestation pressure on the lands where the sheep graze is very high because no antiparasitic treatments were done on these surfaces.

Chapter VII. Metabolic status in sheep from holdings B1 and B2. CSVSA from Bârca commune has 14 non-professional sheep holdings on its territory. For the present work, we studied 2 holdings.

We conducted a case study at farm B1 regarding the evolution of an episode of subclinical ketosis, research carried out in 2020. After conducting the epidemiological investigation and the anamnesis, the clinical examination did not reveal the evolution of some clinical cases because there were uncharacteristic signs (s- noted pregnant animals with non-specific signs such as apathy, indifference, recumbency, tremors of some muscle groups, etc.).

A rapid urine examination using the Combur test was used on 7 urine samples from pregnant sheep, in the last period of gestation. The semi-quantitative results obtained show that in the urine of the analyzed pregnant sheep, ketone bodies were found in medium or significantly increased amounts, increased urine density and slightly acidic pH. It was then continued by blood collection resulting in hypo-

proteinemia, hypoglycemia and hypocholesterolemia; the increase of GOT, GGT and the very significant increase of ketone bodies, making an important discussion of the results. After 2 weeks, (the end of March) we again investigated a batch of 11 sheep observing significantly increased values of betahydroxybutyrate (BHBA)

In the second period, when the sheep were taken to pasture, the analyzes certified the return to normal of the main metabolites, the increase of GGT and the decrease until the disappearance of ketone bodies.

Metabolic monitoring of the sheep on the B2 holding was carried out in 2021 when we wanted to make a comparison between the metabolic variables obtained in lactating sheep in July 2020 and July 2021 when the temperatures were much higher than in previous years. At farm B2 investigated in July 2021, we obtained metabolic profile data that differed from those of July 2020: following biochemical examinations, an increase in GOT, GGT and LDH was found as an indicator of possible subclinical mastitis in the herd.

Chapter VIII. Metabolic status of sheep from farm G. In 2021 and 2022, we carried out a metabolic monitoring of a farm that included a larger herd, composed of: Black-headed Teleorman sheep (they have the largest share in the herd), Tsigae, Turcana , common races (halfbreeds). From each of these breeds, blood samples were collected and their interpretation allowed the observations from which it follows that: in the biochemical examination, pregnant Turcana sheep show: hypoglobulinemia, increase in GOT, GPT, BUN and GGT and in the pasture only the increase GOT During the hematological examination, an increase in no. erythrocytes, a Hb and CHEM and decreased EVM. In sheep of the Tsigae breed, significant eosinophilia and lymphopenia are observed in both the Ţigaie breed and the Teleorman Black-headed Sheep breed.

Chapter IX. Case study. Epidemiological and metabolic surveillance of sheep from holding B3. The case study was carried out at a holding in Bistreţ commune where an episode of clinical ketosis was recorded in the winter of 2022 when the owner had important economic losses resulting in abortions and mortality in pregnant sheep (5 dead sheep). The clinical picture is evident in pregnant ewes in the latter part of gestation, especially in ewes with twin lambs. In these, after a few uncharacteristic signs, the disease once established, after 2-4 days progressed with signs of blindness, ataxia and, finally, sternal recumbency, coma and death. Cerebral hypoglycemia coupled with ketosis, ketoacidosis, and reduced liver and kidney function led to overt clinical signs in pregnant females in which septicemia developed after fetal death. Post-mortem changes demonstrated varying degrees of fatty liver and enlarged adrenal glands and the presence of several decomposing fetuses, indicating fetal death before maternal death.

For a definitive diagnosis (after the death of the pregnant sheep), laboratory tests are performed. As biochemical changes we observed: hypoproteinemia, insignificant; marked hyposideremia, liver enzyme hyperactivity (GGT), hypocalcemia and

hyperketonemia, and hematologically, erythropenia was recorded, and the decrease of Ht, Hb, VEM, HEM and CHEM.

n parallel, we also performed laboratory tests on a batch of 10 sheep suspected of subclinical ketosis in which we found: hypoglycemia, hypoproteinemia, hypo-vitaminosis A, hyposideremia, enzyme hyperactivity, hypocalcemia, hyperketonemia and hematologically erythropenia, decreased hematocrit and hemoglobin and increasing VEM.

Chapter X. Effects of global warming on sheep growth in the southwest Oltenia ecozone, Danube meadow. Answering a large part of the title of the PhD thesis, I carried out current research on the phenomenon known as global warming and its effects on all biodiversity, in our case sheep flocks. There are chapters on global warming with the new temperature record of July 2023, then the chapter on the influence of climate change on all biodiversity. A chapter of personal request is represented by the processed data resulting from climate changes in Romania, in our case from the Oltenia area, with the negative impact on animal breeders and farmers. Thus, we made a presentation on the climate data recorded in the period 2007-2012, with all monthly and annual fluctuations, including the recording of tropical nights, hot days with temperature, humidity and ITU index records. A separate sub-chapter refers to the updated data in the period 2018-2022, during which the research for the realization of this doctoral thesis took place. The temperature anomalies were compared, finding that the year 2023 was the warmest of the last 10 years. the month of July 2023 being the hottest month ever recorded on Earth. Finally, the specialists' estimates for the average global temperatures in the coming years are presented, with a prediction until the year 2100: the "probable range" of increase in the average global temperature on the earth's surface until the year 2100 has been identified, which is between 0.3°C and 4.8°C.

Chapter XI. Case study. The influence of heat stress on sheep in the Oltenia ecozone, in the summer of 2023. The month of July 2023 was extremely hot in most areas of the country, and an important characteristic of this month was the large number of tropical days and nights. Thus, a number of between 20 and 30 tropical days (maximum temperature ≥ 30 °C) were recorded in the southern and southwestern parts of the country. I resorted to the recordings made in the Bechet Regional Center, the closest to the place of our experiments (Bârca commune, Dolj county), where I am a licensed doctor at CSVSA: here I have the Dispensary and the veterinary pharmacy. We made climate records using a hydroscope on certain days in May, June, July and August 2023. We found that in May 2023 both temperature, humidity and temperature-humidity index (ITU) were within normal values for this month of the year, the index temperature-humidity being comfortable for the development of living things. The month of June was thermally comfortable, being much rainier. At the beginning of July 2023, both the temperature, air humidity and ITU registered similar

values to those of June. At the end of July 2023 the ITU recorded over 88 units reaching 95 units but the humidity had relatively average values which made the ITU easier to bear despite the severe heat stress.

On the sheep, these temperatures and the ITU index, even if it was much exceeded, the animals felt the caloric stress, manifesting nutritional and behavioral disorders and the decrease in production.

We have identified the main risk factors of the evolution of thermal stress, recommending to breeders administrative, nutritional, possibly genetic measures (new breeds of sheep resistant to drought, desertification and caloric stress).

Chapter XII. Case study. Episode of ovine babesiosis. We conducted the study at a sheep farm in the Cârna commune with a significant episode of sudden death in sheep, from which 32 sheep aged over 1 year died during 14 days, in July 2023. Until requesting veterinary medicine , the owner started from an initial suspicion of intoxication, which was requested a few days after the onset of mortality, carried out an epidemiological investigation and anamnesis, clinically examined the herd and performed a necropsy examination, taking samples and a corpse which he sent to The Craiova laboratory: after a few days, the answer was negative. The veterinarian returned and found that the severely affected r sheep were dominated by rectal temperature above 39°C and uncharacteristic signs, possibly an anemic state (suspicious of babesiosis). He also performed several necropsies that led him to a presumptive diagnosis of ovine babesiosis and collected blood samples that he sent to FMV Bucharest. The hematological smear result was positive and the PCR test result was negative (we worked with kits for babesia spp., the laboratory did not have kits for babesia ovis). For accuracy, therapeutic diagnosis was resorted to, administering Imizol 1ml/sheep to clinically healthy sheep, and the results confirmed that the episode was successfully resolved.