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Prevalence of Pregnancy Toxemia in Hair Goats in Bingöl Province, Türkiye

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This study aimed to investigate the prevalence of pregnancy toxemia in nine different villages (Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, and Balpınar) in Bingöl province. Blood beta hydroxy butyric acid (BHBA) concentration was measured to diagnose pregnancy toxemia. The study included 398 hair goats that were in the last 3 weeks of their pregnancy, with 303 classified as healthy (H), 25 with clinical pregnancy toxemia (CPT), and 70 with subclinical pregnancy toxemia (SPT). Blood BHBA concentration <0.80 mmol/L was considered H, 8–1.6 mmol/L was considered SPT, and >1.6 mmol/L was considered CPT. It was determined that the average body condition score of the goats was 2.8±0.7 and the average age was 4.5±0.8. Blood BHBA concentrations were analyzed using the FreeStyle Optium Neo H (Abbott Diabetes Care Ltd., Witney, UK). It was determined that there were 303 (76.13%) H goats and 95 (23.87%) pregnancy toxemia goats in Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, and Balpınar villages of Bingöl. It was determined that 70 of the goats with pregnancy toxemia consisted of SPT (73.68%), while 25 of them consisted of goats with CPT (26.32%). As a result, the high prevalence of pregnancy toxemia in goat farms across Bingöl province indicates important management and nutritional misspractices in livestock farming.

Key Words: *Goat, BHBA, prevalence, pregnancy toxemia*

Türkiye'nin Bingöl İlindeki Kıl Keçilerinde Gebelik Toksemisinin Yaygınlığı

Bu çalışmada Bingöl iline bağlı 9 farklı köyde (Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, Balpınar) gebelik toksemisinin prevalansının araştırılması amaçlanmıştır. Çalışmadaki hayvanlarda gebelik toksemisinin belirlenmesi için kan beta hidroksibütirik asit (BHBA) konsantrasyonu ölçümü kullanılmıştır. Çalışma materyalini gebeliğin son 3 haftalık döneminde olan 398 adet kıl keçisi oluşturmaktadır. Kan BHBA konsantrasyonu <0.80 mmol/L Sağlıklı (S), 8-1.6 mmol/L subklinik gebelik toksemili (SGT), >1.6 mmol/L klinik gebelik toksemili (KGT) olarak kabul edildi. Keçilerin 70 tanesi SGT, 25 tanesinin KGT ve 303 tanesinin ise S olduğu belirlenmiştir. Keçilerin vücut kondisyon skorunun ortalama 2.8±0.7 ve ortalama 4.5±0.8 yaşında olduğu belirlendi. Kan BHBA konsantrasyonları FreeStyle Optium Neo H (Abbott Diabetes Care Ltd, Witney, UK) cihazı kullanılarak analiz gerçekleştirildi. Bingöl'ün Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, Balpınar köylerinde 303 (%76.13) adet S, 95 (%23.87) adet gebelik toksemili keçi olduğu belirlendi. Gebelik toksemili keçilerin 70 adedi SPT (%73.68)'den oluşurken 25 adedinin ise KGT'li (%26.32) keçilerden oluştuğu saptandı. Sonuç olarak Bingöl ilinin farklı yerlerindeki keçi işletmelerinde gebelik toksemisinin yüksek olduğu ve hayvancılık işletmelerinde önemli beslenme ve yönetim hatalarının olduğunu göstermektedir.

Anahtar Kelimeler: *Keçi, BHBA, prevalans, gebelik toksemisi*

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Introduction

Pregnancy toxemia is a metabolic disease that occurs in the last 2-3 weeks of pregnancy in goats and sheep (1, 2). In the latter trimester of pregnancy, the fetus grows by 60-80%, and dry matter intake declines, resulting in a negative energy balance (NED) in animals (2). Furthermore, pregnancy with multiple offspring, functional insufficiency of the liver, excessive fat, weakness, irregular feeding, parasitic infestations, sudden weather changes, stress, and the uterus narrowing the area of the rumen due to advanced pregnancy all contribute to the formation of pregnancy toxemia (3-5). The pathophysiological mechanisms behind maternal toxemia remain incompletely understood; nevertheless, it is believed to arise from an imbalance in glucose homeostasis, leading to disruptions in the metabolism of proteins, lipids, carbohydrates, and other nutrients (1, 6, 7). If the fetus and mother's glucose requirements are unsatisfied, the body tries to make up the energy shortfall by breaking down fat stores. Non-esterified fatty acids (NEFA) released as a result of lipolysis are oxidized through the tricarboxylic acid cycle in the liver to produce energy (8). Pregnancy toxaemia is caused by lipid accumulation in the liver from oxidizing fatty acids to ketone bodies (beta hidroksibütirik asit (BHBA), acetic acid, and acetone), which raises the concentrations of ketone bodies in blood, urine, and milk when increased lipid mobilization surpasses the liver's capacity (6, 9).

There are two forms of pregnancy toxemia: Clinical pregnancy toxemia (CPT) and subclinical pregnancy toxemia (SPT). As the disease progresses, if it is not treated in the terminal phase, where nervous symptoms such as the inability to stand, leaning the head on something, muscle tremors, teeth grinding, opisthotonus, and blindness are observed, mortality usually occurs within 3-4 days (1, 5). While Khan et al. (10) determined that the prevalence of pregnancy toxemia was 35% in their study, Scott et al. (11) revealed that this rate was 88.9% in their study. It is stated that if pregnancy toxemia is not treated, the mortality rate can reach up to 80% (1). The disease's extensive prevalence results in severe losses for cattle enterprises and national economies. Gestational toxemia results in significant economic losses, such as the mortality of pregnant goats, veterinary care and treatment expenses, reduced milk production, and progeny loss (12). Consequently, preventative measures rather than treatment for pregnant toxemia are required (1, 5, 13). The incidence of pregnancy toxemia may vary based on nutritional status and environmental factors (1). As a result of this, determining the disease's prevalence in a certain area is essential for creating preventative plans. However, there is not enough information about the prevalence of pregnancy toxemia in goats in our country. Thus, this study aims to investigate the prevalence of pregnancy toxemia in hair goats in Bingöl province.

Materials and Methods

Research and Publication Ethics: The local ethics committee for animal experiments at Bingöl University provided the permission documents needed for the study plan. Work began following the approval of these permits (BÜ HADYEK Committee Number: 2023/02, Decision Number 02/03).

Animals: The study was conducted in 9 different villages (Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, Balpınar) of Bingöl province, located between 41º 20 and 39º - 56º eastern longitudes and 39º - 31 and 36º - 28º northern latitudes of Turkey. The goats body condition score in the study was assessed using the criteria defined by Villaquiran et al. (14). The body condition score of the goats was determined to be 2.8±0.7 on average and 4.5±0.8 years on average. In this study, all of the animals for which BHBA analysis was performed come from family businesses. According to the information provided by the owners of the animals, they feed the animals hay, barley straw, barley silage, and maize silage in barns during the winter and on pastures in the summer.

BHBA Analysis: Blood BHBA concentrations were analyzed using the FreeStyle Optium Neo H (Abbott Diabetes Care Ltd, Witney, UK) device and disposable β-ketone test strips (FreeStyle Optimum β-Ketone, Abbott Diabetes Care Ltd, UK). Before starting the analysis, the device was calibrated by attaching a special calibrator kit to the FreeStyle Optium Neo H device. After the calibration process, 1 drop of blood was taken from the jugular vein in accordance with the technique and scanned into the device, and the results obtained after 10 seconds were recorded. Blood BHBA concentration was accepted as <0.80 mmol/L H, 8-1.6 mmol/L SPT, >1.6 mmol/L CPT (1, 7). In this study, animals with protozoan diseases (such as theileria, babesia, anaplasma), metabolic diseases and animals with any drug application were not included in the study.

Statistical Analysis: The data underwent rigorous statistical analysis using SPSS 26 software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). All results were presented as mean value ± standard deviation. Whether the data showed normal distribution or not was analyzed with the Shapiro-Wilk test. Statistical differences between groups were analyzed with the Kruskall Wallis test. Paired group comparisons were made with the Mann Whitney U test. The one-way ANOVA was followed up with the post hoc Tukey multiple comparisons test. The statistical significance level between groups was accepted as p value <0.05.

Results

According to the blood BHBA concentrations, 303 (76.13%) of the goats in the villages of Garip, Yamaç, Alibir, Yeşil, Sarıçiçek, Gökçeli, Çavuşlar, Ardıçtepe, and Balpınar in Bingöl were found to be healthy, whereas 95 (23.87%) had pregnant toxemia. These goats were determined to be 4.5±0.8 years old on average. Seventy of the goats with pregnant toxemia were found to be SPT (73.68%), while twenty-five of them were found to be CPT (26.32%). The distribution of CPT, SPT and H in different villages of Bingöl province is presented in Table 1. Goat populations in various villages were found to be: 5 out of 36 in Garip village, 6 out of 52 in Yamaç village, 15 out of 65 in Alibir village, 9 out of 38 in Yeşil village, 8 out of 26 in Sarıçiçek village, and 26 out of 48 in Gökçeli village. After investigation, it was found that 15 out of 48 goats, 65 goats in the village of Çavuşlar, 7 out of 56 goats in the village of Ardıçtepe, and 5 out of 37 goats in the village of Balpınar were pregnant toxemia.

Table 1. Shows the distribution of CPT, SPT, and H in different Bingöl provincial villages

Villages	CPT	SPT	H
Garip (n:36)	3 (%8.33)	2 (%5.56)	31 (%86.11)
Yamaç (n:52)	2 (%3.85)	4 (%7.69)	46 (%88.46)
Alibir (n:65)	4 (%6.15)	11 (%16.92)	50 (%76.92)
Yeşil (n:38)	2 (%5.26)	7 (%18.42)	29 (%76.32)
Sarıçiçek (n:26)	2 (%7.69)	6 (%23.08)	18 (%69.23)
Gokceli (n:48)	5 (%10.42)	21 (%43.75)	22 (%45.83)
Çavuşlar (n:40)	2 (%5)	12 (%30)	26 (%65)
Ardıçtepe (n:56)	2 (%3.57)	5 (83.33)	49 (%87.5)
Balpınar (n:37)	3 (%8.11)	2 (%5.41)	32 (%86.49)

CPT: Clinical pregnancy toxemia, SPT: Subclinical pregnancy toxemia, H: Healthy

Blood BHBA concentrations according to different parts of Bingöl province and their statistical significance between groups are shown in Table 2. In the villages of Garip, Yamaç, Ardıçtepe, and Balpınar, it was found that there was a statistically significant difference (P<0.001) between H-SPT and H-CPT. In the villages of Alibir, Yeşil, Sarıçiçek, Gökçeli, and Çavuşlar, it was found that there was a statistically significant difference (P<0.001) between H-SPT, H-CPT, and SPT-CPT. The goats possessed an average body condition score of 2.8±0.7 and an average age of 4.5±0.8.

Table 2. BHBA concentrations (mmol/L) according to different villages of Bingöl province and their statistical significance between the groups

Villages	CPT	SPT	H	P value
Garip (n:36)	3.07±0.32^{a} (n=3)	0.8±00^{a} (n=2)	0.24±0.13^{b} (n=31)	0.001
Yamaç (n:52)	1.9±0.0^{a} (n=2)	0.90±0.14^{a} (n=4)	0.29±0.18^{b} (n=46)	0.001
Alibir (n:65)	2.10±0.54^{a} (n=4)	0.95±0.20^{b} (n=11)	0.32±0.20^{c} (n=50)	0.001
Yeşil (n:38)	1.75±0.07^{a} (n=2)	1.03±0.29^{b} (n=7)	0.41±0.13^{c} (n=29)	0.001
Sarıçiçek (n:26)	2.50±0.0^{a} (n=2)	0.88±0.20^{b} (n=6)	0.39±0.18^{c} (n=18)	0.001
Gökçeli (n:48)	2.30±0.30^{a} (n=5)	1.05±0.20^{b} (n=21)	0.41±0.22^{c} (n=22)	0.001
Çavuşlar (n:40)	1.60±0.0^{a} (n=2)	0.97±0.20^{b} (n=12)	0.37±0.15^{c} (n=26)	0.001
Ardıçtepe (n:56)	1.85±0.35^{a} (n=2)	1.02±0.22^{a} (n=5)	0.25±0.18^{b} (n=49)	0.001
Balpınar (n:37)	2.03±0.51^{a} (n=3)	1.00±0.0^{a} (n=2)	0.28±0.18^{b} (n=32)	0.001

CPT: Clinical pregnancy toxemia, SPT: Subclinical pregnancy toxemia, H: Healthy. Data are given as mean ± standard deviation. a,b,c: Differences between the groups with different letters in the same row are significant (p<0.05).

Discussion

Pregnancy toxemia is a metabolic disorder in which pregnant goats suffer hyperketonemia. This condition is typically triggered by a decrease in energy balance during the last two to three weeks of pregnancy (2, 15). The prevalence of pregnancy toxemia in the world has been researched more in sheep than in goats, and there are a limited number of studies investigating the prevalence of pregnancy toxemia in goats (10, 16). However, no studies investigating pregnancy toxemia in goats have been found in Türkiye. In this study, it was aimed to determine the prevalence of pregnancy toxemia in hair goats in Bingöl province by blood BHBA measurement, and the presented study is the first research conducted in this context in Bingöl province. Animals that develop NED deplete their fat stores. The body consequently produces acetone, acetoacetic acid, and BHBA also referred to as ketone bodies. BHBA is widely preferred in the diagnosis of ketosis because it is found more stable in the blood among the ketone bodies mentioned (1, 11). While the blood BHBA cut-off value for the diagnosis of SPT in goats was determined as 0.8-1.6 mmol/L (1, 17), a value of >1.6 mmol/L was accepted for the diagnosis of CPT (18). In this study, blood BHBA level was preferred in the diagnosis of pregnancy toxemia. In addition, the above-mentioned BHBA levels were used as a reference in this study to group pregnancy toxemia. In this study, it was determined that BHBA levels in the CPT groups were significantly higher than in the H and SPT groups. Previous published literature findings also support the BHBA results of the CPT and SPT groups in this investigation (15, 17).

In both developing and undeveloped nations, goats play a vital role in the economy due to their high productivity of meat, milk, and wool. This is especially true in regions that are too rocky, mountainous, or shrubby for agriculture (7). Pregnancy toxemia is a disease for which prevention strategies need to be developed due to maternal and offspring losses, high treatment costs, and the predisposition of these animals to transitional diseases (retention secundinarum, mastitis, metritis) (15, 19). To take comprehensive measures to prevent the occurrence of pregnancy toxemia, the prevalence of the disease in the region must be known. Furthermore, it is mentioned that regional variations in administrative practices, racial predispositions, and environmental factors may all affect the occurrence of pregnant toxemia (16). In the study conducted by Sathish (16), the prevalence of SPT in sheep was found to be 15.33%, while Gupta et al. (20) found it to be 14.86% in their study. In another study, it was stated that the prevalence of the disease in sheep was approximately 5-20% (6). Pregnancy toxemia prevalence was reported as 13.3% by Ismail et al. (21), 36.7% by Murugeswari and Mathialagan (2), and 35% by Khan et al. (10). In this study, the prevalence of pregnancy toxemia was found to be 23.87%, while SPT was 73.68% and CPT was 26.32%. The results of this study are similar to those of Ji et al. (6), Sathish, (16) and Gupta et al. (20) data, while Murugeswari and Mathialagan (2) and Khan et al. (10) were found to be lower than the results. The possible reason for this may be related to regional differences, economic situation and seasonal conditions.

Many different risk factors play important roles in the occurence of pregnancy toxemia (10, 21). In order to prevent pregnancy toxemia and increase production efficiency, the interaction between animals and the environment must be taken into account (10, 22). Goats biological systems are impacted by physiological stressors, such as seasonal fluctuations (22, 23). In Bingöl province, goats are kept in pastures in summer and in barns in winter due to harsh climatic conditions and snowfall. It is well recognized that the inability to fulfill the rising energy needs of winter and the modifications and adaption process to a new environment have a negative impact on the metabolism (5, 23, 24). Khan et al. (10) found the prevalence of pregnancy toxemia to be higher in winter than in summer. Pregnancy toxemia is more common in the winter, and one reason for this is because in some regions, the months of January and February are the

birth seasons and correspond with the final two to three weeks of pregnancy (21). Pregnancy toxemia has been determined to be 23.87% prevalent in Bingöl province. The reason for this is believed to be a combination of the winter season, physiological stress factors, lack of grazing, and the fact that births take place around this time in reproductive planning.

Like many metabolic illnesses, pregnancy toxemia is known to be significantly impacted by age (25). Older animals with pregnant toxemia have been shown to meet the energy deficit less quickly and insufficiently than younger animals (10). In addition, this situation leads to disruption of metabolic adaptation mechanisms and an increase in NEFA and BHBA concentrations (25). The average age of the goats in this study was 4.5±0.8 years old, which is considered to be an important risk factor that will affect the prevalence of pregnancy toxemia in goats (10, 25).

As a result, the animals included in thisstudy consist of 398 hair goats that were in the last 3 weeks of their pregnancy. It was found that 303 of the goats were healthy (H), 25 were CPT, and 70 were SPT. In light of the findings of this study, it is believed that pregnancy toxemia significantly damages the financial structure of family-run companies in the area and that season and advanced age play a major role in the risk of pregnancy toxemia in hair goats. In further studies, it would be useful to analyze all risk factors affecting prevalence in detail and evaluate a larger study population.

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