ABAH BIOFLUX
Animal Biology & Animal Husbandry
International Journal of the Bioflux Society

# Prevalence and risk factors for pregnancy toxemia of goats in Jordan

Zuhair B. Ismail, Odeh Al-Rawashdeh, Ahmad M. Al-Majali, Fatina Amireh

Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine, Jordan University of Science and Technology, Irbid, Jordan. Corresponding author: Z. Bani Ismail, zuhair72@just.edu.jo

**Abstract**. Pregnancy toxemia is one of the most important and economically devastating diseases in small ruminants. The objective of this study was to investigate the prevalence and risk factors for pregnancy toxemia in different goat breeds in Jordan. Four hundred serum samples from pregnant and recently parturated does were collected and assayed for serum levels of β-hydroxybutyrate (BHB). A serum level of BHB of 0.8 mmol/l or more was considered positive indicator for pregnancy toxemia in individual goats. The overall prevalence of pregnancy toxemia in Jordanian goats was 13.3% and the herd prevalence was 87.5%. Does in late stage of pregnancy were more likely ($P<0.002$) to be affected with subclinical pregnancy toxemia than goats in early stage of pregnancy and from does that had parturated recently. Does from medium-sized herds have more chances ($P<0.005$) to develop subclinical pregnancy toxemia than does of small or large-sized herds. In addition, having twins was significantly associated ($P<0.011$) with the occurrence of subclinical pregnancy toxemia. Shami breed were relatively more likely to have positive levels of BHB than mixed or Baladi breeds. The logistic regression model analysis indicates that age, body condition score and parity have no impact on the occurrence of pregnancy toxemia in Jordanian goats. These results are important because it can help enforce management practices that may prevent the occurrence of this economically important disease in Jordan and elsewhere.
**Key Words**: Small ruminant, disease, twins, hypoglycemia, ketonemia.

**Introduction**. Pregnancy toxemia (twin lamb disease, lambing sickness, lambing paralysis, and lambing ketosis) is a disease of periparturient ewes and does, characterized clinically by impaired nervous functions (Ismail et al 2008; Schlumbohm & Harmeyer 2008; Brozos et al 2011). The disease occurs frequently in malnourished ewes and does in their last 2-3 weeks of gestation. The condition can be manifested in clinical and subclinical forms (Ismail et al 2008; Schlumbohm & Harmeyer 2008; Brozos et al 2011). Pregnancy toxemia follows a period of negative energy balance (NEB), and impaired gluconeogenesis. This result in hypoglycemia and an increase in fat catabolism, leading to high plasma concentration of nonesterified fatty acids (NEFA), along with a high body ketone levels (ketosis) (Rook 2000; Van Saun 2000; Firat & Ozpinar 2002; Moghaddam & Hassanpour 2008; Schlumbohm & Harmeyer 2008).

In ewes, pregnancy toxemia occurs commonly during the last stage of pregnancy especially in ewes carrying multiple fetuses or one single large fetus (Schlumbohm & Harmeyer 2008). Older ewes in their second or subsequent pregnancies are more susceptible to the disease (Rook 2000; Schlumbohm & Harmeyer 2008). The variation in the susceptibility between dams to develop the disease was found to be due to genetic factors, either on the breed level or on the individual level (Rook 2000). On the breed level, the disease appears when certain genetic lines or families show more susceptibility to the disease (Rook 2000; Van Saun 2000). While on the individual level, the disease occurs as a result of individual variation in the ability to regulate glucose homeostasis (Van Saun 2000).

The disease occurs sporadically all over the world; however, herd outbreaks are common in countries with intensive breeding, especially in winter months. Herd outbreaks occur with a high morbidity rate range from 5% to 20%, and a high mortality

rate that exceed 80% in untreated animals (Rook 2000; Van Saun 2000). In Jordan, there are currently no reports on the frequency of pregnancy toxemia in goats, and risk factors that may predispose goats to the condition are largely unknown. The objectives of this study were to report the prevalence and to investigate some of the most important risk factors that contribute to the occurrence of goat's pregnancy toxemia in Jordan.

## Material and Method

All procedures performed in this project were reviewed and approved by the institutional animal care and use committee of Jordan University of Science and Technology (ACUC).

***Investigation area***. The study was conducted on 16 goat-herds located at the central and northern parts of Jordan. The central parts represented by Amman and Zarqa governorates, while the northern parts included Irbid, Ajlun, and Almafraq.

***Herd selection***. The studied herds were composed of Shami, Baladi, and crossed breeds, and were chosen by a stratified- random method from the central and northern parts of Jordan. Five of the 16 herds were located in the central parts, in Amman and Zarqa governorates (at Bader, Al-Bassa, Sweeiseh, Iraq Al-Ameer, and Aldelal areas) and ten herds were chosen from the northern parts in Ajloun and Irbid governorates (at Al-Qala'a area, Rhaba, Qufur Yuppa, Qufur Suum, Al-Nuayyma, Al Mafraq, and Jordan University of Science and Technology (JUST) Agriculture Center). The last herd of the 16 herds represents all cases of pregnant does that came to JUST Veterinary Health Center from different parts of northern Jordan during the studied period. Herds were sorted into three different herd size strata according to the number of adult does. These strata are small-sized herds (5 to 14 heads), medium-sized herds (15 to 50 heads), and large-sized herds (more than 51 heads). From each herd, about 50% of the pregnant does were sampled.

***Herd management***. A questionnaire was used for each farm to provide essential information about the studied herds. The questionnaire included information regarding type and source of the ration and water, vaccination programs, previous diseases or infections, and the percentages of pregnant dams. In most of the herds, grazing was the main source of feed for the animals all over the year. However, grains were provided by the owners only at winter when there was no grass. Only 5 herds were found to depend totally on provided grain-based concentrate ration all over the year. Tap water was the source of drinking water in most of the herds and only in 5 herds, water source was an underground well. All herds were vaccinated against some infectious diseases such as foot and mouth disease, brucellosis, goat pox, and pesti des petites de ruminant (PPR). Deworming using Ivermectine was practiced in only four herds. Natural breeding was practiced in all herds. Estrus synchronization was not used in any of the herds. Most herds began breeding in June, July, and August. Some farmers delayed their animal breeding till October and November.

***Individual management***. For each animal in the study, pregnancy was confirmed using ultrasonography (Dynamic Imaging Sonostar, Livingstone, U.K.). A 5 MHz sector probe for transabdominal and 5 MHz linear probe for transrectal examination were used. In addition, stage of pregnancy as well as the fetus number was determined for each pregnant doe. Animals that had been chosen in the study were of different gestational stages and were categorized according to that criterion into three groups. Group 1 represents does in early gestation (2.5 months pregnant or less). Group 2 represents does in late gestation (3 to 5 months), and group 3 represent does that were recently parturated. A questionnaire was used to get information in regards to age of the sampled does, breed, parity, previous diseases, and type of feeding and water. The does were scored for body condition in a scale from 1 to 5. In addition, does were examined for signs of poor dentation, lameness and concurrent infection.

***Sample collection***. Four-hundred, whole blood samples were obtained by venipuncture, using a vacutainer holder and vacutainer needles in plain vacutainer tubes. The tubes were labeled and transported to the laboratory in ice at 4°C. In the laboratory, serum was separated using a centrifuge (ALC Centrifugette 4206, Milano, Italy) at 1,500 rpm for 5 minutes. Serum was then placed in labeled plastic tubes and stored at –20°C until testing.

***Serum β- hydroxybutyrate (BHB) and glucose concentrations determination***. Serum level of β-hydroxybutyrate was determined using spectrophotometer (Spectrum SP-2000 UV, Witeg labortechink, Werthcim, Germany) and commercially available kits. Serum glucose level was measured using commercially available kit (Glucose GOD-PAP, Linear Chemicals, Barcelona, Spain).

***Statistical analysis***. Chi-square test was used as a test of proportion to assess the association between having a high levels of BHB > 0.8mmol/L and the different investigated variables (breed, age, herd size, gestation state, BCS, parity, and number of feti). All variables with $P<0.05$ (two-tailed) in the univariate analysis is furthermore analyzed by logistic regression model of fixed effects. To construct the model, a backward-stepwise approach was used. Variables were removed from the model by two-tailed $P<0.05$. All statistical analyses were performed using SPSS V10 (SPSS Inc, Chicago, IL, USA).

**Results**. The epidemiological features of the 400 goats included in this study are shown in Table 1. Out of the 400 does examined, 53 (13.3%) had serum levels of β-Hydroxybutyrate more than 0.8mmol/L. Fourteen out of the 16 herds investigated had at least one doe with BHB serum level > 0.8 mmol/L (herd prevalence of 87.5%). No differences in the prevalence of subclinical pregnancy toxemia were detected between the two geographical areas included in the study.

The prevalence of subclinical pregnancy toxemia was significantly higher in does in late stages of pregnancy than does in early stages of pregnancy or does that parturated recently. The prevalence of subclinical pregnancy toxemia was significantly higher in Shami goats than in Baladi or crossbreed goats. The average concentration of BHB in Shami, Baladi, and crossbreed goats with subclinical pregnancy toxemia were 1.1, 0.89, and 0.90 mmol/L, respectively. The percentage does with subclinical pregnancy toxemia was significantly higher in first parity does and in does in their fifth parity of more. Goats in their third parity had the least prevalence of subclinical pregnancy toxemia. No differences were detected in the prevalence of subclinical pregnancy toxemia in does in their second, fourth and fifth parity. The group of goats with overall body condition score of < 2 had significantly more does with subclinical pregnancy toxemia than other groups. Medium-sized herds had significantly higher percentage of does with subclinical pregnancy toxemia than small and large-sized herds. No differences were detected in the prevalence of subclinical pregnancy toxemia in the different age groups of the studied animals. The percentage of does with subclinical pregnancy toxemia in goats that were pregnant with twins was significantly higher than that in does that had single or triplets.

During the study period, 9 animals were diagnosed with clinical pregnancy toxemia. All 9 animals were in their last stage of pregnancy. Clinical signs and levels of BHB and glucose are presented in Table 2.

Results of the linear regression model suggest further that goats in their last stage of pregnancy, goats of Shami breed, goats that come from medium-sized herds and goats pregnant with twins are more likely to suffer from subclinical pregnancy toxemia. The model suggested that BCS, and parity are not risk factors for subclinical pregnancy toxemia (Table 3).

Table 1

Epidemiological features of the 400 goats included in this study

| *Variable* | *No (%)* |
|---|---|
| Age | |
| Less than 2 years | 47 (11.8) |
| 2-4 years | 106 (26.5) |
| 4-6 years | 129 (32.3) |
| More than 6 years | 118 (29.5) |
| Stage of gestation | |
| Early | 149 (37.3) |
| Late | 182 (45.5) |
| Recently parturated | 69 (17.2) |
| Breed | |
| Shami | 169 (42.3) |
| Baladi | 20 (5.0) |
| Crossed breed | 211 (52.8) |
| Parity | |
| 0 | 59 (14.8) |
| 1 | 82 (20.5) |
| 2 | 97 (24.3) |
| 3 | 89 (22.3) |
| 4 | 51 (12.8) |
| More than 5 | 22 (5.5) |
| BCS | |
| Less than 2 | 133 (33.3) |
| 2-3 | 236 (59) |
| >3 | 31 (7.8) |
| Herd size | |
| Small | 53 (13.3) |
| Medium | 91 (22.8) |
| Large | 256 (64) |
| Number of feti | |
| Single | 278 (69.5) |
| Twin | 119 (29.8) |
| Triplet | 3 (0.75) |

Table 2

Clinical signs and serum levels of BHB and glucose in 9 goats with clinical pregnancy toxemia

| *Doe No.* | *Age (Years)* | *Depression* | *Circling* | *Star gazing* | *Acetone breath* | *Recumbency* | *BHB (mmol/L)* | *Glucose (mg/dL)* |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | + | + | - | + | - | 1.0 | 20 |
| 2 | 3 | + | + | - | + | + | 9.6 | 25 |
| 3 | 2 | + | - | + | + | + | 2.4 | 22 |
| 4 | 2 | + | - | + | + | + | 3.5 | 19 |
| 5 | 4 | + | - | + | + | + | 11.1 | 14 |
| 6 | 5 | + | - | + | + | + | 2.2 | 22 |
| 7 | 4 | + | - | + | + | + | 1.1 | 28 |
| 8 | 4 | + | - | + | + | + | 1.5 | 37 |
| 9 | 5 | + | - | + | + | + | 0.88 | 40 |

Table 3

Multivariable logistic regression analysis of variables associated with subclinical pregnancy toxemia in different goat breeds in Jordan (n=400)

| *Variable* | *B* | *SE* | *Exp (B)* | *95% CI $_{OR}$* | *P value* |
|---|---|---|---|---|---|
| Status | -0.596 | 0.196 | 0.551 | 0.375, 0.810 | 0.002 |
| Breed | -0.116 | 0.168 | 0.891 | 0.641, 1.238 | 0.049 |
| Parity | -0.0289 | 0.109 | 1.029 | 0.832, 1.274 | 0.790 |
| BCS | -0.349 | 0.281 | 1.418 | 0.818, 2.459 | 0.213 |
| Herd Size | -0.596 | 0.214 | 1.816 | 1.194, 2.763 | 0.005 |
| Number of feti | -0.710 | 0.278 | 0.492 | 0.285, 0.849 | 0.011 |

**Discussion**. Pregnancy toxemia is an important metabolic disease that affects pregnant ewes and does after a period of negative energy balance (NEB) and impaired gluconeogenesis (Rook 2000; Van Saun 2000; Moghaddam & Hassanpour 2008; Lima et al 2012). The importance of the disease is due to the huge economic losses that result from loss of dams as well as their feti, and the expense of treatment which most of the time appear to be unrewarding.

The number of does with subclinical pregnancy toxemia in this study was 53 out of 400 with an overall prevalence of 13.3%. All these cases were having hypoglycemia. This finding is lower than other findings reported by other investigators who reported a prevalence of 20–40% in ewes in their late stage of pregnancy and with multiple feti. This may be because our study contains does from 3 different stages of pregnancy and that some having only one fetus. Also an important factor is that does are more resistant to the disease than ewes (Ramin et al 2005). It has been found that optimum management and proper nutrition reduce significantly the prevalence rates of the disease (Rook 2000).

Most of the cases (about 22% of does with BHB > 0.8mmol/L) were in their late stages of pregnancy, while those in early stages (8.7%) were similar to those after birth (8%). This agrees well with other studies which suggested that pregnancy toxemia mainly occurs at later stages of pregnancy especially during the last 4 to 6 weeks before parturition (Rook 2000; Van Saun 2000; Ramin et al 2005; Ismail et al 2008). During the last stages of pregnancy, there are significantly increased nutritional demands due to the accelerating development of the fetal placental unit. It has been reported that 80% of fetal growth occurs during the last 6 weeks of gestation (Rook 2000). This occurs at the same time with the reduction in rumen capacity and dry matter intake due to the physical expansion of the gravid uterus in the abdomen and its competition with the rumen. All these events accentuate the NEB and increase the risk of pregnancy toxemia.

In agreement with other studies in ewes, the highest percentage of subclinical pregnancy toxemia cases (19.9%) in this study was observed in does with twins (Rook 2000; Van Saun 2000; Ramin et al 2005). This result suggests that does with triplets have a lower chance of suffering from subclinical pregnancy toxemia. However, it is worth noticing that the number of does with triplets was not significant to impact the results of the study. The risk of subclinical pregnancy toxemia obviously increases in dams carrying multiple feti is due to the fact that the severity of hypoglycemia, as well as the elevation of both plasma concentrations of nonesterified fatty acids (NEFAs), and ketone bodies are directly proportional to the number of fetuses (Lima et al 2012).

The highest percentage of subclinical pregnancy toxemia cases (19%) was observed in Shami breed, followed by Baladi breed (13.1%) and the least was in crossbreeds (12.8%). This variation agreed with the theory that variation in animal susceptibility to the disease may refer to genetic factors on the breed level, as well as it is in the individual level. Certain genetic lines or families appear to be more susceptible to the disease (Rook 2000). Also Shami breed is characterized by a high percentage of delivering twins and triplets in comparison with Baladi breed.

There was no significant effect for age on the percentages of subclinical pregnancy toxemia cases. The highest percentage was seen in animals aged between 2

to 4 years followed by animals older than 6 years. Contradictory to our results, others have reported that the disease is more commonly manifested in older animals (Rook 2000). In this study, most animals were averaged 2 to 4 years of age.

The highest percentage (23%) of subclinical pregnancy toxemia cases was in does in their 5$^{th}$ parity or more. Similar to other studies, the disease in more common in pregnant ewes and does in their second or subsequent pregnancies (Rook 2000). As parity increases, the dam's body become weaker and their ability to control glucose homeostasis decreases leading to a higher risk for having the disease.

The highest percentage of subclinical pregnancy toxemia cases was recorded in does from medium-sized herds (23.1%), and those of large-sized herds had the lowest percent (9%). This result is in agreement with the results obtained previously by Al-Rawashdeh (1999) in bovine ketosis. The reason for this is that all medium-sized herds in the study depend on grazing most of the year, where adverse weather interferes with the animal access to food. While those of large-sized herds, intensive rearing was practiced, where animals provided with better quality feed, mineral supplements, and regular deworming programs.

Similar to other studies, does with low body condition score (BCS < 2) had the highest percentage (15.9%) of subclinical pregnancy toxemia (Rook 2000; Van Saun 2000; Ramin et al 2005). Lower body condition scores may be a consequence to increased fat and protein catabolism that occur in severe undernutrition. However, the study shows that does of BCS > 3 had the lowest percentage (9.2%). This is in contrast with other studies which report that obesity increases the susceptibility of the animal to the disease (Rook 2000; Van Saun 2000). The reason may be due to the small number of does with BCS > 3 in the study.

**Conclusions**. In the present study, subclinical pregnancy toxemia was found to occur commonly in different breeds of goats in Jordan and that herd size, stage of pregnancy, breed and number of feti are major risk factors associated with the occurrence of the disease.

**Acknowledgements**. This project was funded by the Deanship of Research, Jordan University of Sciences and Technology, Irbid 22110, Jordan.

## References

Al-Rawashdeh O. F., 1999 Prevalence of ketonemia and associations with herd size, lactation stage, parity, and postparturient diseases in Jordanian dairy cattle. Prev Vet Med 40:117-125.

Brozos C., Mavrogianni V. S., Fthenakis G. C., 2011 Treatment and control of peri-parturient metabolic diseases: pregnancy toxemia, hypocalcemia, hypomagnesemia. Vet Clin North Am Food Anim Pract 27:105-113.

Firat A., Ozpinar A., 2002 Metabolic profile of pre-pregnancy, pregnancy and early lactation in multiple lambing Sakiz ewes. 1. Changes in plasma glucose, 3-hydroxybutyrate and cortisol levels. Ann Nutr Metab 46:57-61.

Ismail Z. A. B., Al-Majali A. M., Amireh F., Al-Rawashdeh O. F., 2008 Metabolic profiles in goat does in late pregnancy with and without subclinical pregnancy toxemia. Vet Clin Pathol 4:434-437.

Lima M. S., Pascoal R. A., Stilwell G. T., 2012 Glycaemia as a sign of the viability of the foetuses in the last days of gestation in dairy goats with pregnancy toxemia. Ir Vet J 65:1 doi:10.1186/2046-0481-65-1

Moghaddam G. H., Hassanpour A., 2008 Comparison of blood serum glucose, beta hydroxybutyric acid, blood urea nitrogen and calcium concentrations in pregnant and lambed ewes. J Anim Vet Adv 7:308-311.

Ramin A. G., Asri S., Majdani R., 2005 Correlations among serum glucose, beta-hydroxybutyrate and urea concentrations in non-pregnant ewes. Small Rumin Res 57:256–269.

Rook J. S., 2000 Pregnancy toxemia of ewes, does, and beef cows. Vet Clin North Am Food Anim Pract 16:293-317.
Schlumbohm C. Harmeyer J., 2008 Twin-pregnancy increases susceptibility of ewes to hypoglycemic stress and pregnancy toxemia. Res Vet Sci 84:286-299.
Van Saun R. J., 2000 Pregnancy toxemia in a flock of sheep. J Am Vet Med Assoc 217:1536-1539.

Received: 10 February 2015. Accepted: 18 March 2015. Published online: 03 April 2015.
Authors:
Zuhair Bani Ismail, Jordan University of Science and Technology, Faculty of Veterinary Medicine, Department of Veterinary Clinical Sciences, Jordan, Irbid, 22110, e-mail: zuhair72@just.edu.jo
Odeh Al-Rawashdeh, Jordan University of Science and Technology, Faculty of Veterinary Medicine, Department of Veterinary Clinical Sciences, Jordan, Irbid, 22110, e-mail: odeh@just.edu.jo
Ahmad M. Al-Majali, Jordan University of Science and Technology, Faculty of Veterinary Medicine, Department of Veterinary Clinical Sciences, Jordan, Irbid, 22110, e-mail: almajali@just.edu.jo
Fatina Amireh, Jordan University of Science and Technology, Faculty of Veterinary Medicine, Department of Veterinary Clinical Sciences, Jordan, Irbid, 22110, e-mail: famireh@yahoo.com

How to cite this article:
Ismail Z. B., Al-Rawashdeh O., Al-Majali A. M., Amireh F., 2015 Prevalence and risk factors for pregnancy toxemia of goats in Jordan. ABAH Bioflux 7(1):53-59.