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IMPACT OF VARIOUS TEMPERATURES ON THE HEMATOLOGICAL AND BIOCHEMICAL INDICES, PREGNANCY, GROWTH AND SURVIVAL RATE OF ANGORA RABBIT IN CAPTIVITY

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Article Info

Abstract

The Angora rabbit, named scientifically as Oryctolagus cuniculus, is one of the most well-known candidates for its cashmere-like fleece which is very rich wooly fiber used in the making of woolen fabrics. The indicator of hematological and biochemical aspects is extremely valuable in determining the health and well-being of animals. A one-year experiment was carried out in the Mardan area with 20 adult female angora rabbits to evaluate how same life conditions affect pregnancy outcomes, growth rate, hematological and biochemical parameters including cholesterol level. The temperatures of the forecast region were tracked down daily throughout all seasons, winter (December-February), spring (March-May), summer (June-August) and fall (September-November). The biomedical data, specifically, the body weight, pregnancy, the hematological and biochemical indices were recorded. The ambient temperature in winter, spring, summer, and autumn was 18.3ºc, 30.15ºc, 35.85ºc, and 29.2ºc. Several blood parameters from pregnant and non-pregnant rabbits were studied. Pregnant rabbits showed significantly lower RBC and WBC counts, lymphocyte ratios, and hemoglobin concentrations than non-pregnant rabbits ($p<0.05$). The biochemical features of pregnant and non-pregnant rabbits were examined. Pregnant rabbits showed significantly lower amounts of total protein, albumin triglyceride, cholesterol, calcium, and phosphorus than non-pregnant rabbits ($p < 0.05$). In summer, female rabbits had lower ($p<0.05$) erythrocyte count, hemoglobin concentration, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration. Summer was the season with the highest albumin level values. Winter had a greater mean total protein level than spring, summer, and fall. The rabbit puts on weight in the winter, which is the finest season, and there is no such difference found in the summer. Winter has high pregnancy rates, indicating that it is the best season for breeding. All analysis was done through SPSS tools such as one-way ANOVA and paired t-test.

Keywords:
Angora rabbit, biological parameters, pregnancy, temperature, Mardan

Introduction

Rabbits are small mammals in the family Leporidae of the order Lagomorpha, found in several parts of the world. (Rewatkar et al., 2013). Rabbits are homoeothermic or warm-bloodedness mammal with fast metabolic rate, slow heat loss and no sweat glands. The Angora rabbit (O. cuniculus) is a breed known for its long, soft, and luxurious wool, which is highly valued in the textile industry (Rafat et al., 2007). Angora rabbits show poorer viability, prolificacy and growth than normal-haired ones. The explanations for this include genetic factors and the effect of heat stress in connection with long wool (Eiben et al.,2000).

The study of the composition and quantity of the red (erythrocytes), white (leucocytes), and platelets that make up blood is known as hematology and how to diagnose and track diseases using these results Tomes, (2021). Hematological research is useful in understanding how blood properties relate to the environment from an ecological and physiological approach. (Etim et al., 2014). In addition to evaluating the animals' metabolic state, biochemical and hematological characteristics could be impacted by several variables, such as age, sex, fertility, and seasonal changes (Raouf et al., 2021). As per Afolabi et al., (2012), alterations in hematological parameters are frequently employed to assess several bodily states and to identify stressors resulting from environmental, dietary, and/or pathological variables (Etim et al.,2014). Biochemical examination of blood determines the amount of chemical substance released by bodily tissues during the metabolism of a specific substance. It provides critical information regarding the function of the liver, kidney, and other organs (Shreya et al., 2023).

It is often known that rabbits are quite sensitive to temperature extremes in the environment. Compared to rabbits confined at 15 ºC, those exposed to ambient temperature of 25 ºC for 12 hours a day gained less weight. Temperatures beyond 28 ºC might lead to heat-induced physiological stress. High temperatures reduce the amount of feed consumed, which in turn reduces growth since less digestible energy is consumed (Okab et al.,2008). It is commonly known that the biggest risk factor affecting the growth performance of growing rabbits is heat stress. Besides, under heat stress conditions, growing rabbits prefer to direct energy toward heat dissipation rather than the growth and building of muscles and tissues. In hot and semi-hot climes, HS generally had a negative effect on both male and female rabbits' reproductive performance, which presented a risk to the rabbit industry. Reduced fertility, embryo development, litter size, litter weight, and milk production were seen in rabbits kept under high stress (HS) conditions. High ambient temperature exposure reduces the weight and length of the developing embryo and decreases the live body weight of rabbits (Marai et al.,2002). This suggests that a comprehensive approach is necessary to understand the complex interactions between temperature and other factors affecting the hematological and biochemical parameters of Angora rabbits.

MATERIALS AND METHODS

Study area

The experiment used 10 adult pairs of Angora rabbits. The experiment aimed to determine how temperature affects Angora rabbit growth, pregnancy, and hematological and biochemical indicators. The year-long research took place at Abdul Wali Khan University in Mardan.

Seasonal Assessment

The study examined the way the four seasonal temperatures affected angora rabbit hematological and biochemical markers, as well as pregnancy rates and weight gain. This four-term system was known as winter, spring, summer, and autumn.

During the research, the daily mean and extreme temperatures in degrees Celsius were meticulously observed. The impact of seasonal variations in environmental variables on rabbit behavior was investigated by analyzing their reactions.

Pregnancy assessment

To determine pregnancy, angora rabbits were mated at regular intervals. Physical behavior examinations and pregnancy kits were used to confirm the pregnancy of the female angoras.

Blood Sampling

Female rabbit blood samples were collected during the winter (December-February), spring (March-May), summer (June-August), and autumn (September-November) months. In January, blood samples were taken from a pregnant rabbit.
Blood was collected from the rabbit's marginal ear vein, providing two samples: 2 mL for hematology and 3 mL for biochemical analysis. The study was approved by the local ethics committee and adhered to the "Guide for the Care and Use of Laboratory Animals" (National Research Council, 1996).
Blood samples for hematological assays were delivered to the laboratory within three hours of collection and rapidly analyzed.

Hematological analysis

Blood samples from rabbits were taken, and hematological tests were done on the same day. The samples were taken in EDTA tubes to avoid blood clots. The samples were delivered to the clinical laboratory. Erythrocytes, hemoglobin, hematocrit, MCV, MCH, MCHC, eosinophils, basophils, leukocytes, monocytes, and lymphocytes were all counted.

Biochemical analysis

To avoid clotting, the blood was collected in gel tubes for biochemical analysis. To extract serum samples, the blood was centrifuged at 1300 x g for 15 minutes before being split into Eppendorf tubes. Separated sera were stored at -20°C before analysis. It was delivered to the clinical laboratory. Total protein, albumin, triglyceride, cholesterol, glucose, ca (calcium), (mg) magnesium, and P (phosphorus) levels were measured.

Body Weight assesment

Every day, the bunnies were weighed individually on a computerized scale. To estimate the best season for Angora rabbit development, we took the monthly average of the collected data.

Statistical Analysis

The collected data will be subjected to appropriate statistical analyzes, such as ANOVA, t-tests, regression analysis, and so on, to determine whether there are statistically significant differences between temperature groups in terms of pregnancy rates, growth rates, hematological parameters, and biochemical markers.

Results

Seasonal evaluation of blood parameters

The study discovered a strong link between season and hematological indicators.

During the winter, erythrocyte, hemoglobin, MCH, and MCHC levels were highest, but declined in the summer. Conversely, hematocrit and MCV levels rose in the summer and fell in the winter and spring. The study discovered that the leukocyte count, and lymphocyte rate were lower in the summer and autumn months compared to winter. Summer was the season with the highest albumin levels.

Seasonal evaluation of body weight

Angora rabbits' body weight fluctuated significantly seasonally due to natural adaptations and environmental influences. Heat stress lowered their appetite and energy intake over the summer, causing them to lose weight. Furthermore, decreased wool production during this time reduced their overall metabolic rate. In contrast, as temperatures decreased over the winter and early spring, Angora rabbits gained weight. This was because they needed more energy to keep their bodies warm and stimulate rapid wool growth, which necessitated a greater caloric intake. These weight shifts were a normal physiological reaction to seasonal variations, allowing them to adjust to varied environmental situations Figure 1.

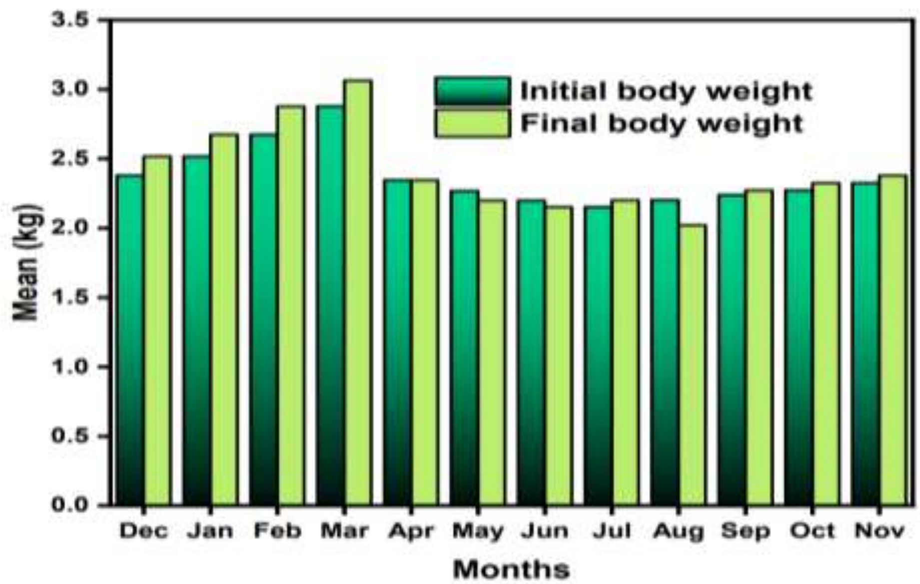

Figure 1. Initial and Final body weights (in Kgs) in Angora rabbits throughout the year which include 4 seasons winter (December-February), spring (March-May), summer (June-August) and fall (September-November)

Seasonal evaluation of pregnancy rate

The study found that pregnancy rates were greater in the winter months of December, January, and February, indicating that winter was the ideal time to breed. In the spring season, March and April showed positive pregnancy, whereas May showed negative pregnancy. As a result, this season features a tiny pregnancy. In the summer, June and July showed negative pregnancy, whereas August showed positive pregnancy, indicating that summer was not the optimum time to breed. September suggested a negative pregnancy, but October and November indicated a favorable pregnancy. The fall season was also limited, Figure 2a and b.

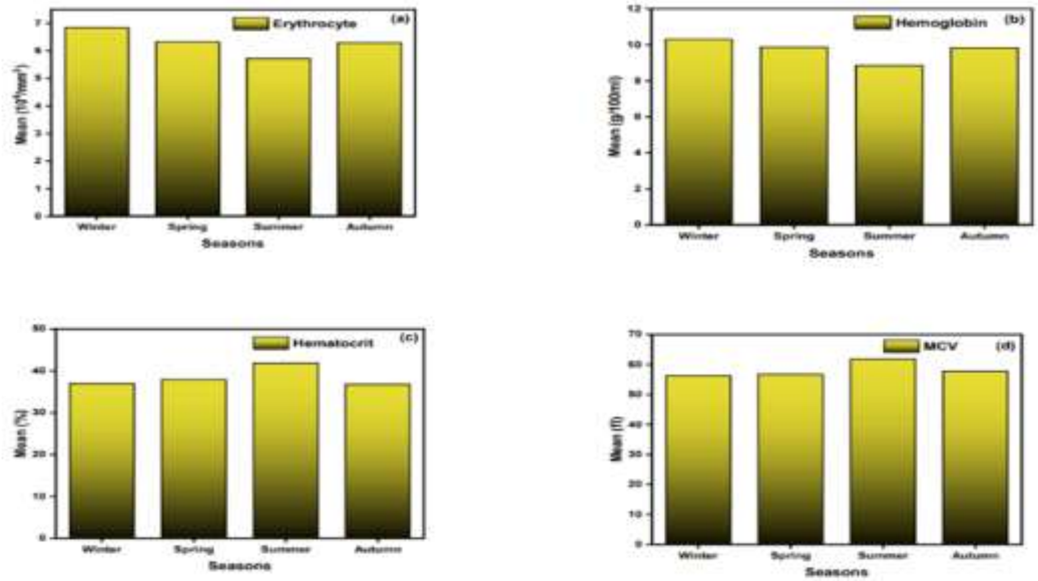

Figure2a. Erythrocyte counts in angora rabbits throughout the seasons (b) Hemoglobin count in angora rabbits throughout the seasons (c) Hematocrit count in angora rabbits throughout the seasons (d) MCV count in angora rabbits throughout the seasons.

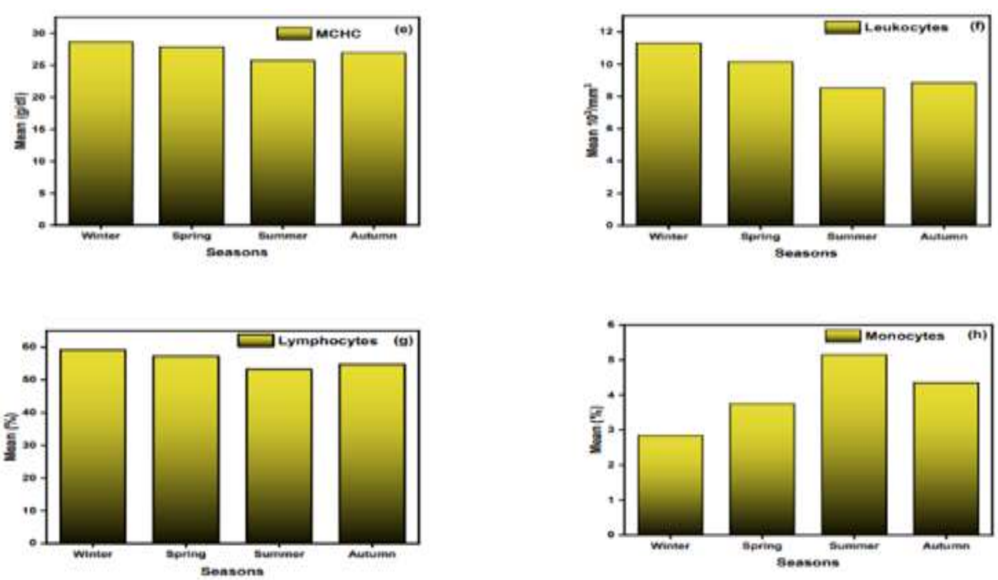

Figure 2b. (e) MCHC (f) Leukocyte count (g) Lymphocyte count (h) Monocyte count in angora rabbits throughout the seasons

Hematological Analysis

Several blood parameters of both pregnant and non-pregnant rabbits were analyzed and are shown in the graph below. When pregnant rabbits' RBC and WBC counts, lymphocyte ratios, and hemoglobin concentrations were compared to those of non-pregnant rabbits, there was a substantial ($p<0.05$) drop. In comparison to non-pregnant rabbits, the MCV value of pregnant rabbits was considerably higher ($p<0.05$) in the other hematological indices Figure 3 a, b and c.

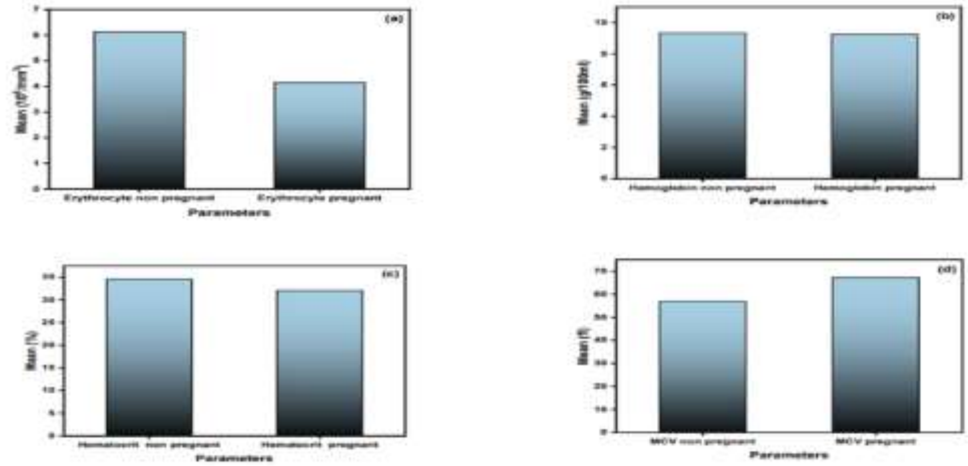

Figure 3a. Erythrocyte count in pregnant and non-pregnant angora rabbits (b) hemoglobin count in pregnant and non-pregnant angora rabbits (c) hematocrit count in pregnant and non-pregnant angora rabbits.

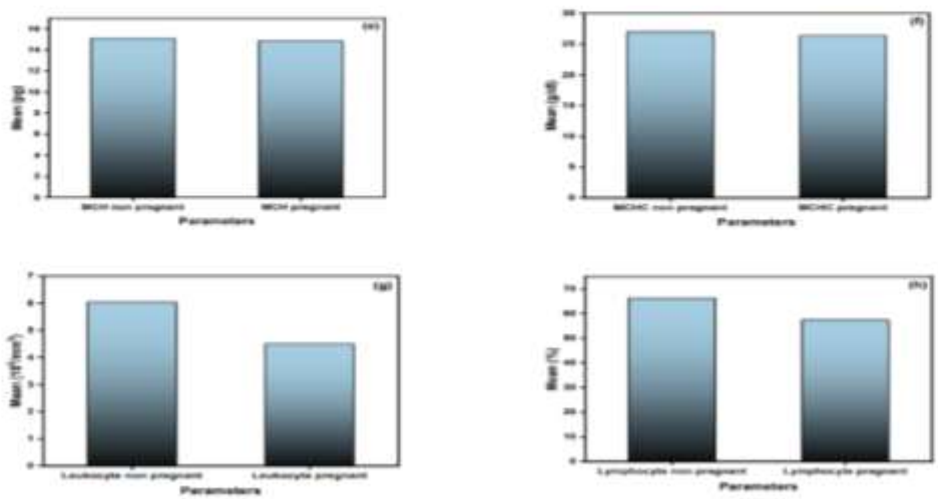

Figure 3b. MCH counts in pregnant and non-pregnant angora rabbits (f) MCHC count in pregnant and non-pregnant angora rabbits (g) Leukocyte count in pregnant and non-pregnant angora rabbits (h) Lymphocyte count in pregnant and non-pregnant angora rabbits.

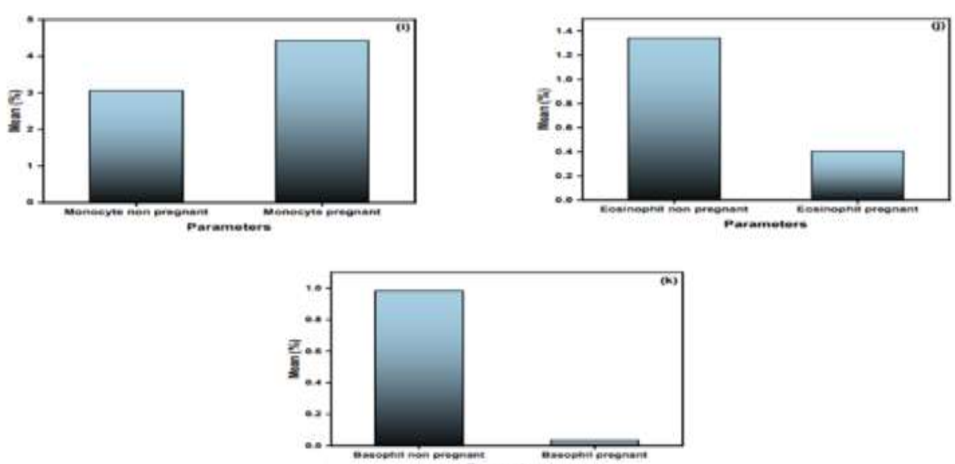

Figure 3 c. (i) Monocyte counts in pregnant and non-pregnant angora rabbits (j) Eosinophil count in pregnant and non-pregnant angora rabbits (k) Basophil count in pregnant and non-pregnant angora rabbits

Biochemical Analysis

The biochemical characteristics of both pregnant and non-pregnant rabbits were investigated. Compared to non-pregnant rabbits, pregnant rabbits had significantly reduced levels of total protein, albumin triglyceride, cholesterol, calcium, and phosphorus ($p<0.05$). When compared to non-pregnant rabbits, the mean glucose level in pregnant rabbits was considerably greater ($p<0.05$).

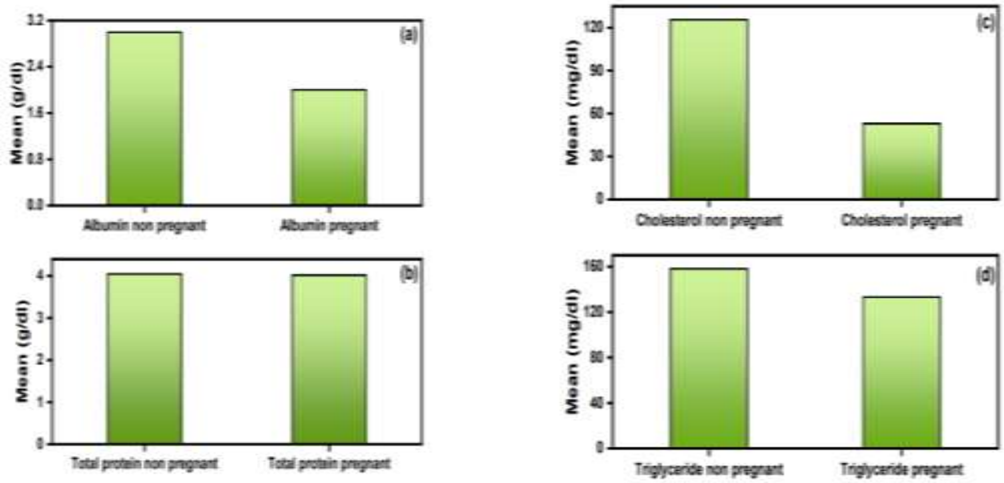

Figure 4 a. (a) Albumin count in pregnant and non-pregnant angora rabbits (b) Cholesterol count in pregnant and non-pregnant angora rabbits (c) Total protein count in pregnant and non-pregnant angora rabbits (d) Triglyceride count in pregnant and non-pregnant angora rabbits.

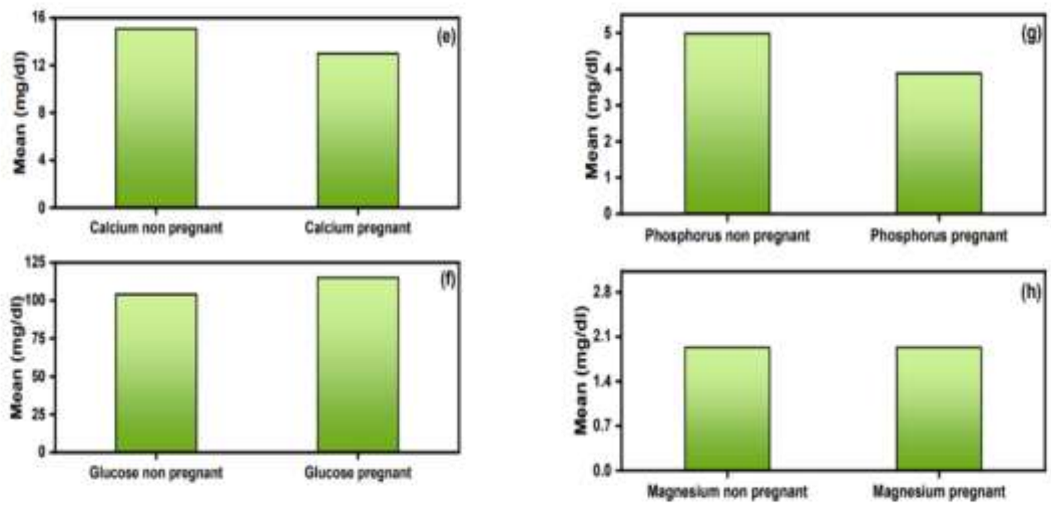

Figure 4 b. (e) Calcium count in pregnant and non-pregnant angora rabbits (f) Phosphorus count in pregnant and non-pregnant angora rabbits (g) Glucose count in pregnant and non-pregnant angora rabbits (h) Magnesium count in pregnant and non-pregnant angora rabbits

Discussion

This study analyzed several blood parameters in both pregnant and non-pregnant rabbits. The study found that pregnancy and season had varied effects on hematological and serum biochemical variables.

The current study found a substantial reduction in erythrocyte count (4.14±0.01) and hemoglobin levels (9.24±0.01) in pregnant rabbits. A related study (Cetin et al., 2009) reported a decrease in red blood cell and hemoglobin levels. This was similar with previous research in New Zealand rabbits (Kim et al., 2002). Pregnant animals may have lower erythrocyte count and hemoglobin levels due to hem dilution, resulting in physiological anemia (Ozegbe et al., 2001).

A reduction in leukocyte (leaning 4.49±0.1) and lymphocyte ratio (leaning 57.34±0.03) was kindly observed in the pregnant rabbits as opposed to the non-pregnant rabbits. The results didn't differ from those obtained in the study by Kim et al. (2002). The recent study owned the fact that in pregnant rabbits MCV went up (67.2±0.02), which is equivalent to a lot of immature red blood cells, in agreement with previous studies (Kim et al., 2002). The investigation found that pregnant rabbits had a lower hematocrit value (32.09±0.01) compared to those that are not pregnant (34.55±0.05). In contrast to a research by (Haneda et al.,2010), pregnant Japanese white rabbits had lower RBC count, hematocrit value, and hemoglobin levels by the 28th day of pregnancy compared to non-pregnant rabbits. Our investigation found no significant variations in other hematological markers, such as MCH, MCHC, monocyte, basophile, and eosinophil, between pregnant and non-pregnant rabbits. (Cetin et al.,2009) discovered no significant differences ($p>0.05$) in any hematological variables between pregnant and non-pregnant rabbits.

In this study, pregnant angora rabbits had lower biochemical values, including total protein, albumin, triglycerides, cholesterol, calcium, and phosphorus, whereas glucose levels increased significantly. (Cetin et al.,2009) found reduced levels of total protein, albumin, triglycerides, cholesterol, calcium, and phosphorus in pregnant angora rabbits, whereas glucose levels rose.

The study discovered a strong link between season and hematological indicators.

During the winter, erythrocyte, hemoglobin, MCH, and MCHC levels were greatest, while decreasing in the summer. In contrast, hematocrit and MCV levels climbed in the summer and fell in the winter and spring. (Cetin et al.,2009) observed that erythrocytes, hemoglobin, MCH, and MCHC levels decrease in winter, whereas hematocrit and MCV levels increase in summer.

In rabbits, elevated MCH and MCHC levels during winter may imply enhanced erythropoietin activity. Erythropoietin activity is affected by several factors such as activity, nutrition, temperature, and gender. The study indicated that leukocyte counts and lymphocyte rates were lower in summer and fall than in winter. (Cetin et al.,2009) observed that leukocyte and lymphocyte levels are lower in the summer and fall, but higher in the winter and spring. Photoperiod can induce seasonal variations in lymphocyte numbers and kinds. Summer was the season with the highest albumin levels. (Cetin et al.,2009) found that albumin levels peak in the summer. During summer, increasing osmotic pressure prevents water from exiting blood vessels, resulting in higher albumin levels.

The study found that angora rabbits' body weight decreases in summer but increases dramatically in winter and spring. Research (Nusrat et al., 2020) suggests that winter is the best season for maintaining healthy body weight. According to (Prasanna et al.,2006), rabbits consume less meals at high temperatures (35 C) due to environmental stress. The study found that winter months (December, January, and February) have greater pregnancy rates, suggesting that winter is the optimal season to breed. Pregnancy rates are higher in March and April, but lower in May.

As a result, this season has a tiny pregnancy. Summer months are not ideal for breeding, with negative pregnancy rates in June and July and positive rates in August. September suggests a negative pregnancy, but October and November indicate a favorable pregnancy. The fall season is also limited. (Marai et al.,2002) observed that heat stress in female rabbits reduces conception rate, embryonic development, litter size, litter weight, and milk supply. It also delays puberty and increases death rates before and after weaning.

Conclusion

The study demonstrates the impact of temperature on pregnancy and body growth. Winter is the optimal time for breeding and body weight increases. There are differences in hematological and biochemical markers between pregnant and non-pregnant angora rabbits. Most indicators are lower in pregnant rabbits.

AUTHORS CONTRIBUTIONS

Amna Gul Collected and analyzed the data and drafted manuscript. Zia ul Islam helped in blood collection and analysis. Muhammad Qayash khan has supervised the whole research. Saman Yaqub has modified the manuscript. Brekhna Faheem statistically analyzed the data. Gule Tanzila reared the rabbit brood stock for experiment. Amal Rahim helped with data collection. Zubair Ali has selected and provided healthy rabbits for experiments and help in data collection.

CONFLICT OF INTERES

All authors declared that they have no competing interests.

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