academicJournals

Vol. 14(43), pp. 3001-3005, 28 October, 2015
DOI: 10.5897/AJB2015.14953
Article Number: A902BF655937
ISSN 1684-5315

http://www.academicjournals.org/AJB

African Journal of Biotechnology

Full Length Research Paper

Effect of reproductive status on body condition score, progesterone concentration and trace minerals in sheep and goats reared in South Sinai, Egypt

Mahmoud Fathy Nawito[1], Karima Ghonaimy M. Mahmoud[1]*, Mohamed Mahmoud M. Kandiel[2], Yousef F. Ahmed[1] and Ahmed Sayed A. Sosa[1]

[1]Department of Animal Reproduction and Artificial Insemination, National Research Centre, Dokki, Tahrir Street, 12622 Giza, Egypt.
[2]Department of Theriogenology, Faculty of Veterinary Medicine, Benha University, Kaliobia, Egypt.

Received 31 August, 2015; Accepted 30 September, 2015

This study aimed at evaluating the effect of reproductive stage on nutritional status, and hormonal and trace mineral levels in sheep and goats reared in harsh arid conditions in South Sinai, Egypt. Egyptian local breeds of sheep (n=74) and goats (n=58) raised in South Sinai were examined by means of transabdominal ultrasonography to verify single vs. multiple feti pregnancy or non-pregnant status. Serum samples were collected for assessment of progesterone and trace minerals (selenium (Se), zinc (Zn), copper (Cu) and iron (Fe)) levels. Evaluation of the nutritional status of animal flocks showed that the mean body condition score was below the average levels, but did vary noticeably with pregnancy or between sheep and goats. Serum progesterone concentrations were significantly higher in pregnant animals with multiple fetuses than those bearing single fetus ($p < 0.01$), and both were higher than the respective values in non-pregnant animals ($p < 0.001$). Serum trace mineral levels were too low with no significant differences caused by pregnancy, number of fetuses or animal species. From these results, we could conclude that the state of pregnancy and fetal number have a significant influence on serum levels of progesterone. However, the harsh conditions in South Sinai in terms of scarce precipitation, low cultivation chances and high water salinity are the major factors influencing nutritional status or trace mineral levels in the reared small ruminants, regardless of the reproductive state or species.

Key words: Goat, pregnancy, progesterone, reproductive status, sheep, South Sinai, trace minerals.

INTRODUCTION

Sheep and goats are considered as productive species, although most breed of both species show yearly reproductive cycles. However, reproductive functions in these species are also controlled by other extrinsic factors, for instance, social and sexual interactions and nutritional status.

Body condition score (BCS) assessment in sheep and goats is beneficial to monitor the change in body reserves

*Corresponding author. E-mail: karima_mahmoud@hotmail.com. Tel: +201001827716. Fax: +20233370931

at various production stages throughout the year. In livestock systems, based on grazing and concentrate supplementation at milking, BCS monitoring is very essential to allow rapid changes in the dietary management in animals with low condition score (Molina et al., 1991).

Progesterone, “the hormone of gestation”, is the key hormone important for preparing the uterus for implantation and maintaining myometrial quiescence (Rahman, 2006). The inspection of blood progesterone as well as ultrasonography are commonly used to determine the number of fetuses in pregnant animals (Medan et al., 2004) which is important for organizing the technological regimen of feeding and breeding, herd replacement, and to protect animals from metabolic diseases during the late stage of pregnancy. Linzell and Heap (1968) showed that progesterone was produced mainly by the ovaries (up to 10 mg/day, placenta 0 mg/day) in goats, whereas the placenta made the largest contribution (up to 14 mg/day, ovaries about 2 mg/day) in sheep.

In practice, weather conditions in Sinai do not facilitate animal breeding due to the absence of arable grounds and accessible fresh water. South Sinai is an area near the hyper-arid region with salt affected natural resources (water, soil, plants, etc.) and its main water resources originates from groundwater. Therefore, feed resources in the region represent one of the main obstacles to animal production development. The health and reproductive performance of grazing livestock depends on the adequacy and availability of both essential macro and micro elements from pastures (Robinson et al., 2006).

Selenium is a non-metal with similar chemical properties as sulphur. It is a crucial ingredient of the glutathione enzyme system; and its deficiency could make cells to be susceptible to oxidation. In ruminants, the needs for selenium are generally low. However, forages and different feedstuffs produced in some parts of the world are lacking selenium. Selenium supplementation is required in these regions to anticipate economic losses in animal production. Extensive research indicates that selenium and vitamin E play imperative crucial role in shielding the body from diseases (Wilkins and Kilgour, 1982). Supplementation with selenium and vitamin E has been demonstrated to diminish the frequency of retained placenta, metritis and increase the rate of uterine involution (Boland, 2003).

Zinc is necessary in the production of more than 70 enzymes in the body. Due to its contribution in such a large number of catalysts, zinc is basic for vitality and protein digestion system. Limited zinc intake during pregnancy has serious impacts in animals, leading to fetus loss or premature labor (Apgar and Everett, 1991). Serious zinc deficiency is uncommon in practice. However, borderline zinc deficiency is more frequent in ruminants. Zinc supplementation of ewes prior to mating and throughout pregnancy increased the number of lambs produced by 14% (Masters and Fels, 1980). Lamb survival rate and birth weights were higher in ewes when supplementation was begun later in pregnancy (Masters and Fels, 1980).

Copper is one of the essential trace metals which is necessary in maintaining the functioning of living organisms. It is required for the function of over 30 proteins including superoxide dismutase, ceruloplasmin, lysyl oxidase, cytochrome c oxidase, tyrosinase, dopamine-β-hydroxylase and hephaestin (Prohaska, 2011). Moreover, reproductive performance of animals may be compromised if copper levels are marginal. Copper complexes with GnRH and interact with GnRH receptors and modulate intracellular signaling in the gonadotrope cells of the anterior pituitary (Michaluk and Kochman, 2007). Common copper deficiency symptoms in cattle include delayed or suppressed estrus, decreased conception, infertility and embryo death (Corah and Ives, 1991).

Iron is required for the synthesis of haemoglobin and myoglobin as well for the functioning of cytochrome enzymes of electron transport chain. Iron participates in transport of oxygen to tissues, maintenance of oxidative enzyme system and is associated with ferretin formation (Khillare et al., 2007). Although forages are rich in iron, low availability in certain feeds could affect adversely, ruminant reproduction. Lower level of serum iron results in anemia, which in turn affects reproduction, adversely leading to increased number of insemination per conception and occasionally leading to abortion (Kumar et al., 2011). Low levels of serum iron cause failure of conception and embryonic death due to change in molarity of the oviductal fluid in repeat breeding (Jain, 1994).

The aim of the present work was to identify the body condition score, progesterone concentrations and levels of trace minerals in the serum of pregnant and non-pregnant sheep and goats raised under the arid conditions of South Sinai in Egypt.

MATERIALS AND METHODS

Animals and blood sampling

A total number of 74 sheep and 58 goats from Egyptian local breeds raised in South Sinai were examined for reproductive status by transabdominal ultrasonographic examination using 5 MHz linear array probe (SonoVet 600; Medison, Korea). Accordingly, animals were classified into three groups: carrying single fetus, multiple fetuses and non-pregnant. Blood samples (10 ml) were collected from the jugular vein of all animals into non-heparinized Vacutainer tubes. Serum was collected upon centrifugation at 3000 rpm for 20 min, labeled and stored at -20°C until analyzed.

Assessment of body condition score

BCS) was measured manually. In sheep, the lumbar region is the principal site for BCS determination (Russel et al., 1969), while in

Table 1. Effect of reproductive status on body condition score in sheep and goats reared in South Sinai, Egypt.

Physiological status	Sheep	Goats
Pregnant	2.38 ± 0.19	2.56 ± 0.13
Non-pregnant	2.27 ± 0.08	2.26 ± 0.08

goats, the rib cage and sternum also play a role (Mendizabal et al., 2010). Scoring of sheep and goats is done using a BCS ranging from 1.0 to 5.0, with 0.5 increment. An animal of BCS 1.0 is extremely thin with no fat reserves and BCS of 5.0 represents an over conditioned (obese) animal.

Progesterone analysis

Progesterone level in serum was determined by the use of progesterone EIA kits (Cat. No. 4210-96, Syntron Bioresearch, CA, USA) according to the method of Boscos et al. (2003).

Mineral concentrations

Serum trace minerals (Zn, Cu, Fe and Se) concentrations were measured in thawed sera at room temperature using a flame atomic absorption spectrophotometer (Spectra AA20, Varian Co., Australia, Switzerland).

Statistical analysis

Data were subjected to ANOVA using SPSS for Windows Version 16.0, Statistical Software. Comparison of means was carried out by least square difference (LSD). An independent student *t*-test was used to find the significant differences between sheep and goats. Differences were considered to be significant at P<0.05.

RESULTS

Effects of litter size on body condition score in sheep and goats

Surveying of nutritional status of animal flocks reared in South Sinai revealed that the mean body condition score was 2.38 ± 0.19 and 2.56 ± 0.13 vs. 2.27 ± 0.08 and 2.26 ± 0.08 in pregnant versus non-pregnant sheep and goats, respectively. These values were not significantly different regardless of the status of pregnancy or animal species (Table 1).

Effects of litter size on serum progesterone levels in sheep and goats

Serum progesterone concentrations in sheep with single or multiple fetuses vs. non-pregnant animals were 23.21 ± 3.38, 59.66 ± 5.63 versus 4.08 ± 0.98 ng/ml, respectively. On the other hand, goats with single or multiple fetuses versus non-pregnant animals were 16.96 ± 1.52 and 25.32 ± 3.32 versus 6.50 ± 1.67 ng/ml, respectively (Table 2). Animals bearing more than one fetuses had higher levels of progesterone as compared to those bearing single fetus ($p < 0.01$), and both were higher than those in non-pregnant animals ($p < 0.001$).

Table 2. Effect of reproductive status on serum levels of progesterone (ng/ml) in sheep and goats reared in South Sinai, Egypt.

Physiological status	Sheep	Goats
Single pregnancy	23.21 ± 3.38b	16.96 ± 1.52b
Multiple pregnancy	59.66 ± 5.63a	25.32 ± 3.32a
Non-pregnant	4.08 ± 0.98c	6.50 ± 1.67c

Values (mean±SE) with different letters within the same column are significantly different at P< 0.05.

Effects of litter size on serum trace mineral levels in sheep and goats

Serum trace minerals in pregnant and non-pregnant sheep and goats raised in South Sinai are presented in Table 3. Statistical analysis of serum levels of selenium, zinc, copper and iron revealed not significant effect of the pregnancy condition on their levels in sheep and goats. Moreover, no statistical difference was observed in the concentration of trace element between sheep and goats.

DISCUSSION

Sheep and goats are very important species due to their biological identity, such as short generation interval, twinning, short growth periods and medium space requirements. Many arid and semi-arid regions in the world have soils and water resources that are too saline for most of the common conventional crop systems. Sheep and goat breeding appears as an alternative, although the harsh conditions could have an effect on the reproductive performance of the animals (Robinson et al., 2006).

The most ideal approach to evaluate the state of an animal is to assess whether it has the correct weight for its age and physiological stage. On the other hand, it is not always possible to weigh an animal on a scale, e.g. under field conditions, in mountainous areas; at the same time, weighing ewes in advance may induce stress and negatively influence animals. Body condition score is an estimate of the muscle and fat development of an animal. Muscles become toned and larger with exercise, but there is a point where additional muscle size cannot increase more. In this way, the body condition score is known as a safe and realistic option technique to assess an animal's condition. Routine scoring of the body condition of animals can help detect potential problems

Table 3. Effect of reproductive status on serum levels of trace minerals (ppm) in sheep and goats reared in South Sinai, Egypt.

Trace element	Sheep		Goats	
	Pregnant	Non-pregnant	Pregnant	Non-pregnant
Selenium (Se)	0.11 ± 0.01	0.09 ± 0.01	0.13 ± 0.02	0.12 ± 0.01
Zinc (Zn)	4.30 ± 0.10	4.74 ± 0.18	4.01 ± 0.28	4.65 ± 0.24
Copper (Cu)	0.44 ± 0.02	0.50 ± 0.03	0.40 ± 0.04	0.49 ± 0.05
Iron (Fe)	4.69 ± 0.29	4.82 ± 0.42	4.52 ± 0.24	4.91 ± 0.09

that might cause a decrease in reproduction performance. In the present study, pregnant sheep and goats had greater values for body condition score, although these values were not significantly different as compared to non-pregnant animals. These results may be attributed to the fact that the lipid reserves of the animal change during the breeding period, with an increase during pregnancy, and mobilization at parturition and the beginning of lactation (Bauman and Currie, 1980). According to Navarre et al. (2012), pregnant goats should have a body condition score between 2.5 and 3, 45 days before parturition. Aliyari et al. (2012) suggested that reproductive performance in ewes with BCS = 3 was improved, while the lambing rate was reduced in ewes with BCS = 3.5 or more. A previous study by Gaias (2011) demonstrated that the general average of BCS was 2.65 in sheep; with the most frequent classes of observed BCS which is 2.75 (corresponding to 38.2% of observations) and the 2.50 (corresponding to 29.2% of total observations). The minimum BCS detected was 2.0 and the maximum BCS detected was 4.0.

Measurement of progesterone is a widely used technique for monitoring ovarian function and for assessing pregnancy in animals (Terzano et al., 2012). In the current study, progesterone level showed significant differences between sheep and goats bearing one or multiple fetuses or non-pregnant animals. Generally, pregnant small ruminants exhibit higher ($p<0.05$) levels of progesterone than non-pregnant (Al-Sobaiyl, 2010). Robertson and Sarda (1971) recorded a tendency for blood progesterone concentration to be higher in sheep bearing two fetuses. Moreover, Boscos et al. (2003) demonstrated a significant positive correlation between progesterone concentration and the number of lambs or kids born, and further analysis indicated that this relationship is not a simple linear one. Also, in goats, maternal serum progesterone concentrations are positively correlated with the number of corpus luteum and fetus (Khan and Ludri, 2002). Higher levels of progesterone in pregnant sheep versus goats in the present study might be attributed to the differences in the sources of progesterone in species (Linzell and Heap, 1968).

Trace minerals are an integral compartment for energy production, enzyme activity, hormone synthesis, vitamins and tissue synthesis, oxygen transport, and other physiological processes related to wellbeing, development and reproduction (Gurdogan et al., 2006). An evaluation of trace minerals status reveals whether elements supplementation of the animals' feed is satisfactory and whether productivity is prone to be enhanced with supplementation of trace elements (Solaiman et al., 2006). Current results showed that the serum trace minerals (selenium, zinc, copper and iron) were not significantly different with pregnancy condition in sheep and goats reared in South Sinai. Concerning zinc level changes, plasma Zn levels in goats change as per the physiological status, with the most outstanding differences after parturition and during lactation (Ahmed et al., 2001). Conversely, Gurdogan et al. (2006) did not discover changes in serum Zn levels in sheep with single or twin fetuses, neither during parturition nor during lactation. At the same time, abortion in sheep was not related with alternations in circulating Zn levels (Naziroğlu et al., 1998). Concerning blood selenium changes, Gurdogan et al. (2006) did not find changes in serum Se levels in pregnant sheep that bore single or twin fetuses, however, their levels were significantly lower in animals approaching lambing, that is, 150 days of pregnancy. Zvonko et al. (2004) demonstrated that the serum Se level was significantly higher in sheep at 20 days before lambing when compared with lactating ones. Scarce information is available regarding the effect of reproductive status on serum Se levels in goats, although in general, sheep have significantly higher concentrations than goats and cattle (van Niekerk et al., 1990). Regarding serum Cu changes, Mohammed et al. (2014) showed that serum Cu did not vary among physiological stages in sheep, however, high percentages of serum Cu below the critical level (<0.5mg/L) were found at all physiological stages in sheep (40-60%) reared in Trinidad. On the contrary, Al-Sobaiyl (2010) stated that Cu levels were noticeably higher in pregnant than non-pregnant does. The difference between current results and previous studies indicated a significant higher level of Cu in pregnant as compared to non-pregnant animals which might be attributed to geographical area, breed differences and time of blood sampling. Concerning iron levels, Al-Sobaiyl (2010) found that iron concentration was not affected neither by season nor by pregnancy in

goats. On the other hand, Tanritanir et al. (2009) found that Fe levels increase after parturition.

It could be concluded that the reproductive status has a significant impact on serum levels of progesterone. However, the region of South Sinai with its characteristics of poor land conditions, low cultivation chances and high salinity may contribute to low body condition of pregnant sheep and goats. Finally, trace minerals levels appeared not to be significantly influenced by the reproductive status.

Conflict of interests

Authors did not declare any conflict of interest.

ACKNOWLEDGEMENT

This research was supported by National Research Centre, Cairo, Egypt. Project No (10060116).

REFERENCES

Ahmed MMM, Hamed TFM, Barri MES (2001). Variation of zinc and copper concentrations in the plasma of Nubian goats according to physiological state. Small Rumin. Res. 39(2):189-193.

Aliyari D, Moeini MM, Shahir MH, Sirjani MA (2012). Effect of body condition score, live weight and age on reproductive performance of Afshari ewes. Asian J. Anim. Vet. Adv.7(9):904-909.

Al-Sobaiyl KA (2010). Effect of breeding season and pregnancy status on serum progesterone, sodium, potassium, copper and iron of estrous synchronized Aradi goat does. Saudi J. Biol. Sci.17(3):259-263.

Apgar J,Everett GA (1991). Low zinc intake affects maintenance of pregnancy in guinea pigs. J. Nutr. 121(2):192-200.

Bauman DE, Currie WB (1980). Partitioning of nutrients during pregnancy and lactation: a review of mechanisms involving homeostasis and homeorhesis. J. Dairy Sci. 63(9): 1514-1529.

Boland M (2003). Trace minerals in production and reproduction in dairy cows. Proceedings of the 2003 Western Canadian Dairy Seminar. pp. 319-330.

Boscos CM, Samartzi FC, Lymberopoulos AG, Stefanakis A, Belibasaki S (2003). Assessment of progesterone concentration using enzymeimmunoassay, for early pregnancy diagnosis in sheep and goats. Reprod. Domest. Anim. 38(3): 170-174.

Corah LR, Ives S (1991). The effects of essential trace minerals on reproduction in beef cattle. Vet. Clin. North. Am. Food Anim. Pract. 7(1): 41-57.

Gaias G (2011). Body condition score and body composition of Sarda dairy ewes. Scienze dei Sistemi Agrari e Forestali e delle Produzioni Alimentari, Università Degli Studi Di Sassari. p. 148.

Gurdogan F, YildizA, Balikci E (2006). Investigation of serum Cu, Zn, Fe and Se concentrations during pregnancy (60, 100 and 150 days) and after Parturition (45 days) in single and twin pregnant sheep. Turk. J. Vet. Anim. Sci. 30(1): 61-64.

Jain GC (1994). Mineral profiles during anoestrum and repeat breeding in bovines. Inter. J. Anim. Sci. 9:241-245.

Khan JR,Ludri RS (2002). Hormonal profiles during periparturient period in single and twin fetus bearing goats. Asian Aust. J. Anim. Sci. 15(3): 346-351.

Khillare KP, Sahatpure SK, Vanlalpeka K, Bombatkar RS, Tijare GS (2007). Trace minerals and reproduction in animals. Intas. Polivet. 8(2):308-314.

Kumar S, Kumar PA, AbdulRazzaque WA, Dwivedi DK (2011). Importance of micro minerals in reproductive performance of livestock. Vet. World 4(5):230-233.

Linzell JL, Heap RB (1968). A comparison of progesterone metabolism in the pregnant sheep and goat: sources of production and an estimation of uptake by some target organs. J. Endocrinol. 41(3): 433-438.

Masters DG.,Fels HE (1980). Effect of zinc supplementation on the reproductive performance of grazing Merino ewes. Biol. Trace Elem. Res. 2(4):281-290.

Medan M, Watanabe G, Absy G, Sasaki K, Sharawy S, Taya K(2004). Early pregnancy diagnosis by means of ultrasonography as a method of improving reproductive efficiency in goats. J. Reprod. Dev. 50(4): 391-397.

Mendizabal JA, Delfa R, Arana A, Purroy A (2010). A comparison of different pre and post-slaughter measurements for estimating fat reserves in Spanish Blanca Celtiberica goats. Can. J. Anim. Sci. 90(3): 437-444.

Michaluk A, Kochman K (2007). Involvement of copper in female reproduction. Reprod. Biol. 7(3): 193-205.

Mohammed A,Campbell M, Youssef FG (2014). Serum copper and haematological values of sheep of different physiological stages in the dry and wet seasons of central Trinidad. Vet. Med. Int. 2014: 972074.

Molina A, Gallego L, Sotillo JL (1991). Evolucion anual del peso vivo y de la nota de condicion corporal de ovejas de raza Manchega en diferentes estrado productivos. Arch. Zootec. 40: 237-249.

Navarre CB, Baird AN, Pugh DG (2012). Diseases of the Gastrointestinal System. Chapter 5. In: Sheep and Goat Medicine (Second Edition). Baird,DGPN (Ed.) W.B. Saunders, Saint Louis. pp. 71-105.

Naziroğlu M, Çay M, Karataş F, Çimtayl, Aksaka IM (1998). Plasma levels of some vitamins and elements in aborted ewes in Elaziğ region. Turk. J. Vet. Anim. Sci. 22 (2): 171-174.

Prohaska JR (2011). Impact of copper limitation on expression and function of multicopper oxidases (ferroxidases). Adv. Nutr. (Bethesda, Md.). 2(2): 89-95.

Rahman ANMA (2006). Hormonal changes in the uterus during pregnancy- lessons from the ewe: A review. J. Agric. Rural Dev. 4(1): 1-7.

Robertson HA, Sarda IR (1971). A very early pregnancy test for mammals: its application to the cow, ewe and sow. J. Endocrinol. 49(3): 407-419.

Robinson JJ, Ashworth CJ, Rooke JA, Mitchell LM, McEvoy TG (2006). Nutrition and fertility in ruminant livestock. Anim. Feed Sci. Technol. 126(3-4): 259-276.

Russel AJF, Doney JM, Gunn RG (1969). Subjective assessment of fat in live sheep. J. Agric. Sci. 72(3):45l-454.

Solaiman SG, Shoemaker CE, D'Andrea GH (2006). The effect of high dietary Cu on health, growth performance, and Cu status in young goats. Small Rumin. Res. 66(1-3): 85-91.

Tanritanir P, Dede S, Ceylan E (2009). Changes in some macro minerals and biochemical parameters in female healthy Siirt hair goats before and after parturation. J. Anim. Vet. Adv. 8(3): 530-533.

Terzano GM, Barile VL, Borghese A (2012). Overview on Reproductive Endocrine Aspects in Buffalo. J. Buffalo Sci. 1(2): 126-138.

van Niekerk FE, Cloete SWP, Barnard SA, Heine EWP (1990). Plasma copper, zinc and blood selenium concentrations of sheep,goats and cattle. S. Afr. J. Anim. Sci. 20 (3): 144-147.

Wilkins J, Kilgour R (1982). Production responses in selenium supplemented sheep in northern New South Wales. 1. Infertility in ewes and associated production. Aust. J. Exp. Agric. 22(115): 18-23.

Zvonko A, Marcela S, Zvonimir S (2004). The influence of age and the reproductive status to the blood indicators of the ewes. Archiv für Tierzucht. 47(3):265-273.