LAMBING AND EMBRYONIC MORTALITY RATES IN AWASSI AND BARKI EWES AND THEIR CROSSES THROUGHOUT THREE DIFFERENT MATING SEASONS IN THE WEST- COASTAL REGION OF EGYPT

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ABSTRACT

This study was conducted to determine whether early diagnosis of pregnancy with ultrasonography and reintroduction of rams to non-pregnant ewes for additional two estrous cycles would increase pregnancy rate and increase lambing crop. Fertile rams were introduced to a total of 335 Awassi and Barki ewes and their crosses for 30 days during three consecutive mating seasons: spring, autumn, and winter. Transrectal ultrasound diagnosis of pregnancy was carried out after 30 days of rams' introduction to detect pregnant ewes and to reintroduce rams for additional 30 days to the non-pregnant ones. In spring, Barki ewes had greater (P<0.01) lambing rates than Awassi ewes (61.4 vs. 16.7%). In autumn, all breeds had comparable lambing rates. In winter, Barki ewes had greater lambing rate (61.4%) compared to Awassi ewes (16.7%) and their cross ewes (26.9%). Embryonic mortality rates for Awassi ewes (45.5%) in spring were higher than Barki ewes (17.6%). In autumn all ewes had similar rates of embryonic mortality, with average rate of 23.8% for the whole three breeds. In winter, the cross ewes had the highest rate of embryonic mortality (69.6%) compared to both Barki (30%) and Awassi ewes (50%). Awassi ewes had the highest rate of behavioral and ovarian anestrus in spring (63.3%) and winter (66.7%) compared to (10.8%) in autumn. Barki ewes had the highest rate of anestrus in spring (25.7%) compared to 11.8% in autumn and 12.3% in winter. Furthermore, the percentage of ewes that conceived after matings during the first estrous cycle after rams' introduction as determined by transrectal ultrasonography of uterine contents on day 30 was greatest for Barki ewes (66.2%) in winter and for cross ewes (65.4%) in autumn. Season of mating had a significant effect on urea nitrogen (UN) concentration in sera of ewes under study, however breeds had no significant effect but Awassi tended to have more serum UN than Barki and cross ewes. More importantly, reproductive status had a significant effect on serum UN concentrations. Ewes that lost their pregnancy during the course of the experiment as well as the anestrus ewes showed greater urea concentrations in their sera compared to the quick response ewes that conceived and maintained pregnancy to term. Progesterone concentration determined on days 30, 60 and 90 after rams' introduction differed in the ewes that were considered anestrus, quick response ewes, and ewes with embryonic mortality (2.0, 5.3, and 4.3ng/mL, respectively).

Key words: ultrasound, lambing rate, embryonic mortality, sheep, urea, progesterone

INTRODUCTION

Early diagnosis of pregnancy in small farm animals such as sheep and goats plays a major role in increasing efficiency of the reproductive management in sheep farms (Karen et al., 2004). Early identification of non-pregnant ewes allows breeders to make proper decisions to increase their profit either by applying some reproductive approaches such as estrous synchronization or reintroduction of fertile rams to smaller breeding groups of these recently-diagnosed non-pregnant ewes. Pregnancy could be diagnosed by ultrasonography as early as 40-90 days of gestation using the real-time B-mode ultrasonography with great success. However, in many breeds the technique requires the ventral part of the ewe to be shaved, which is considered a laborious and time consuming practice in larger farms. The transrectal ultrasonography diagnosis of pregnancy utilizing the 5.0 and 7.5MHz transducers can recognize pregnancy as early as 17-19 days of gestation by detection of non-echoic fluid in gravid uteri (Fowler and Wilkins, 1984). Moreover, other embryonic tissues and placental structures can be detected at 26-28 days of gestation (Buckrell et al., 1986). Therefore, the objectives of the current study were to extend the mating season by additional two estrous cycles for the recently-diagnosed non-pregnant ewes to allow for more fertile matings and; to test the feasibility of the application of transrectal ultrasonography routinely in commercial sheep farms for early identification of non-pregnant ewes. This will allow breeders to implement proper management strategies and hence increase lambing crops.

MATERIALS AND METHODS

This study was carried out at Bourg El-Arab Research Station, 50 Km west of Alexandria (31° 15` N and 30° 10` E), Egypt. Animals were kept in open barns and had free access to feed and water. The experiment was carried out on the same group of animals over three different mating seasons: spring (May, mean temperature 25°C); autumn (September, mean temperature 28°C); and winter (January, mean temperature 17°C).

Animals and management:

A total of 335 ewes (spring, May [Awassi, n=30; Barki, n=69], autumn, September [Awassi, n=37; Barki, n=68; crosses, n=36], and winter, January [Awassi, n=12; Barki, n=57; crosses, n=26]) were used in this study. The flock under investigation has two pure breeds (Awassi, imported from Syria) and the native Barki breed and their crosses.

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The research Station has a preset protocol for breeding where open ewes are introduced to fertile rams in May for 30 days (about two estrous cycles) and rams are then removed. All ewes that become pregnant are expected to give birth in September or October in the same year. Ewes that will not lamb by October or diagnosed pregnant by hand palpation after 3 months of expected pregnancy date, which is considered inaccurate with voluminous ewes, will be ready to be bred in January. Similar practice is followed in autumn and winter. In the current study we modified this breeding protocol by introducing fertile rams for two additional estrous cycles with ultrasound detection of pregnancy one month after rams' introduction, and then pregnant ewes were removed to a separate pen. Furthermore, open ewes were left with rams for additional two cycles (30 days) and were then scanned for the second time to detect pregnant ewes to be moved to the pregnant ewes' pen. Rams were removed and the open ewes were held for later scanning of pregnancy after 30 days to detect any new pregnancy occurrences. The diagnosed pregnant ewes were gathered in separate groups and open ewes were isolated to be bred in the following mating season. Every occasion of ultrasound scanning, all ewes were scanned whether they were previously diagnosed pregnant or not. Pregnant ewes were rescanned to detect maintenance of pregnancy and incidence of embryonic mortality up to the third month of the breeding season. The working protocol is presented in Figure 1.

Ultrasonographic examination:

Ultrasonographic examination of ewes was done by using a Dynamic Imaging, Concept MLV scanner ultrasound device equipped with a 5.0 and 7.5 MHz linear probe (dual frequency probe) for early diagnosis of pregnancy. The transducer was fitted to a plastic rod as an adaptor to enable manipulation of the probe after being inserted in the rectum (Garcia et al., 1993). The probe was covered with ultrasound grade gel and inserted into the rectum approximately 10cm deep. Ultrasound examinations were conducted via the rectum on a standing position. The ultrasound machine was connected to a portable video recording machine to record all scanning sessions. Animals were banned from feed for 12 hours before examinations. Rectum was cleaned if necessary from feces and the lubricated probe was gently inserted into the rectum until the anechoic content of the bladder was visible on the screen. The probe was rotated clockwise 90° and anti-clockwise 180° to scan the entire reproductive tract. Detection of the anechoic uterus, alantoic fluid, embryo proper, or fetus were all considered a positive signs of pregnancy (Fig. 2). Ventral abdominal lifting was done while conducting the scanning by the operator or the assistants if necessary. Scanning was performed 30 days after rams' introduction. Ultrasound detection of pregnancy was repeated on days 60 and 90 after onset of mating season to determine pregnancy occurrence and determine the percentage of embryonic mortality.

Blood urea nitrogen and hormonal analysis:

Blood samples were collected by jugular veinpuncture every time animals were scanned for pregnancy. Serum was harvested and stored at -20°C until assayed. Urea nitrogen in the serum was determined by colorimetric kits (Diamond Diagnostic, Egypt). Circulating concentrations of progesterone (P4) hormone were determined by ELISA using commercial kits provided by Calbiotech, Inc., Spring Valley, CA. The range of the standards used was 0.0 - 40.0 ng per ml. The inter- and intra-run precision had coefficients of variation of 2.9 and 4.8%, respectively.

Statistical analysis:

Data were analyzed using the procedure GLM (SAS, 1996). Lambing rates, embryonic mortality, percentage of anestrus ewes, and percentages of ewes conceiving during estrous cycles one and two or three and four after rams' introduction were used in the model as dependent variables. The effects of season and breed and results of ultrasound scanning on days 30, 60, and 90 after rams' introduction were tested. Plasma urea nitrogen and progesterone were analyzed in a separate model that included season, breed, and reproductive status effects and their interactions.

RESULTS AND DISCUSSION

Lambing rates:

Based on lambing performance of the tested ewes, lambing rates were calculated and are shown in (Table 1). In spring season, Barki ewes had greater ($P<0.01$) lambing rate (61.4%) than Awassi ewes (16.7). In autumn season, all breeds had comparable lambing rates (67.6, 69.1, and 58.3%, for Awassi ewes, Barki ewes and their crosses, respectively). In winter season, Barki ewes had greater ($p<0.01$) lambing rates (61.4%) compared to Awassi ewes (16.7%) or their cross ewes (26.9%). The percentages of pregnant ewes either in Barki or Awassi were identical in spring and winter seasons but Barki ewes had always greater pregnancy rates than Awassi in both seasons. In spring and winter seasons, Barki ewes responded favorably to prolonged mating interval for additional two estrous cycles, but Awassi and cross ewes did not respond to this protocol. Pregnancy rates for the Awassi breed during the spring season are comparable to those for East Friesian (EF) composite and Romney breeds in New Zealand when their estrus was induced in spring season (de Nicolo et al., 2007). Also the percentage of East Friesian composite ewes and Romney ewes that failed to conceive was 41% and 43% in spring season compared to 9% and 4% in autumn and winter seasons, respectively. Also lower pregnancy rates were reported for East Friesian composite ewes and Romney ewes when bred in early and late spring. All ewes in the current study responded positively to the modified breeding protocol in autumn as they were in the true

breeding season for all breeds. The highest lambing rates in Awassi and cross ewes were noted in autumn. Hormonal intervention seems to be the only alternative when Awassi ewes or the cross ewes are to be bred off season. Similar conclusions were reported by Wildeus (1999) who reported that in anovular ewes, estrus must be synchronized but also initiated. Systems that rely on regression of active CL are not effective under these conditions. However, providing exogenous progesterone in combination with gonadotropin can be used to induce and synchronize estrus in anovular ewes.

Embryonic mortality:

Early detection of pregnancy by Real-time Ultrasound enabled us to detect rates of embryonic mortality (Table 2). The use of ultrasonic detection of embryonic mortality is a valid alternative to the post mortem examination method (Kaulfuss et al., 1996). Embryonic mortality rates for Awassi ewes (45.5%) in spring were greater ($P<0.01$) than that for Barki ewes (17.3%). In autumn, all ewes had comparable rates of embryonic mortality (24.2, 21.7, and 27.6% for Awassi ewes, Barki ewes and their crosses, respectively). In winter, the cross ewes had the highest rate ($P<0.01$) of embryonic mortality (69.6%) compared to both Barki (30.0%) and Awassi ewes (50.0%). Awassi ewes had the least rate of embryonic mortality in autumn (24.2%) compared to spring (45.5%) and winter (50.0%) but these differences were not significant. This could be due to the little number of pregnant ewes who lost their pregnancy (2/4) in January. These increased rates of embryonic mortality in Awassi ewes in spring and winter seasons are worthy of further studies in an attempt to minimize these losses. Decreased pregnancy rates in Awassi ewes in spring and winter seasons are due to increased embryonic mortality rather than failure in ovulation or conception. This holds a promise and a chance of getting 3 lamb crops every two years with providing proper care and treatments to minimize embryonic loss incurred during spring and winter seasons. Barki ewes had an acceptable rate of embryonic mortality throughout the three seasons (17.7, 21.7, and 30.0% for spring, autumn, and winter, respectively). Such low rates of embryonic mortality highlight the fitness of Barki ewes to adapt to the seasonal variations and environmental challenges. The slightly increased rate of embryonic mortality in Barki ewes in winter (30.0%) is indicative of increased rate of conception in response to prolonged mating season and necessitates further managerial measures to minimize such losses during the harsh winter conditions.

Response to rams' introduction:

After introduction of rams to ewes, considerable percentages of ewes failed to respond and continued their anestrus behavior. These ewes are detected as never been diagnosed pregnant with the ultrasound scanning and never gave birth during each respective season. Awassi ewes had the highest rate of anestrus in spring (63.3%) and winter (66.7%) (Table 3) compared to (10.8%) in autumn. Similar data were reported by Cushwa et al. (1992) in May matings with Targhees and Rambioullet ewes. The current data indicate that Awassi ewes are strict seasonal breeders and if ever breeding is attempted out of season an estrous synchronization protocol should be considered.

Previous reports indicated that 78% of the anestrus ewes did not have an ovulation that resulted in a functional CL until at least 10 days after joining with rams (Nugent and Notter, 1990). Barki ewes had their highest ($p<0.01$) rate of anestrus in spring (25.7%) compared to 11.8% in autumn and 12.3% in winter. Thus, it seems that the success of inducing breeding activity in anestrus ewes increases as the start of the normal breeding season approaches (Nugent et al., 1988).

Conception to fertile matings:

Percentage of ewes that conceived to matings occurring during the first and second estrous cycles after rams' introduction as determined by ultrasonographic detection of uterine contents on days 30 was greatest ($P<0.01$) for Barki (66.2%) ewes in winter and for cross ewes (65.4%) in autumn (Fig 2). It is evident from the data that the percentages of ewes responding earlier to rams' introduction and diagnosed pregnant at the first ultrasound scanning are greater in winter (51.4, 66.2, and 52.8% for Awassi, Barki, and their cross ewes, respectively). Such response is due to the fact that the ewes were in a transition period after being in the autumn breeding season. Unlike Awassi, Barki, and cross ewes in winter, the response of Awassi and Barki ewes in autumn was delayed because they did not have ovulation or a functional CL at the beginning of season. Similar conclusions were reported by (Nugent and Notter, 1990).

Blood/plasma urea nitrogen (PUN):

Data in Fig (4) show the concentrations of PUN in the sera of ewes in response to season, breed, and reproductive status. Season had significant ($p<0.0$) effect on urea concentration in the sera of ewes under study. However, breed had no significant effect on PUN concentration, although Awassi ewes tended to have more PUN (50.2 mg/100ml) than Barki (49.0 mg/100ml) and cross ewes (45.6 mg/100ml) irrespective of season. More importantly, reproductive status had a significant ($p<0.01$) effect on PUN concentrations. Our results showed that ewes that lost their pregnancy during the course of the experiment and the anestrus ewes had greater urea concentrations in their sera (53.3 mg/100ml and 49.7 mg/100ml, respectively) compared to the quick response group (43.4 mg/100ml) that conceived and gave birth without losing their pregnancy. High plasma urea nitrogen

(PUN) concentrations were reported to be associated with decreased fertility in lactating dairy cows suggesting decreased embryo viability through effects exerted on the oocyte or embryo (Roads et al., 2006). Dairy cows with decreased conception rates associated with elevated milk urea nitrogen (MUN) have normal cyclic activity, suggesting that poor reproductive performance is a result of fertilization failure or embryonic death prior to maternal recognition of pregnancy (Larson et al., 1997). Elrod and Butler (1993) reported that uterine pH was significantly lower on day 7 of the estrous cycle in early lactation dairy cows fed excess dietary protein. Furthermore, nitrogenous waste products (e.g., NH3 and urea) are thought to be toxic to bovine gametes and/or embryos and have been suggested to play a role in reproductive inefficiency in dairy cows (Staples et al., 1993). It is evident from the results in hand that ewes with excellent reproductive performance had less urea nitrogen in their blood and this is supported by data from other species, indicating that the toxic effect of urea in reproductive fluid affects the embryos as early as day 7 after fertilization.

Serum progesterone (P4):

Progesterone concentrations from ewes with different reproductive status during the scan dates 30, 60, and 90 days after rams' introduction are shown in figure 5. A slight interaction ($p<0.15$) was detected between scan dates and status. The anestrus ewes had a steady low concentrations of progesterone (2.2, 1.8, and 2.0ng/ml) in scan dates 30, 60, and 90, respectively. Ewes with a quick response performance had higher ($p<0.01$) P4 concentration (5.30 ng/ml) than the anestrus ewes (2.0 ng/ml) and ewes with embryonic mortality (4.30 ng/ml). Also, the difference in P4 concentration was significant ($p<0.01$) between ewes with embryonic mortality and anestrus ewes. Season of mating had a significant ($P<0.05$) effect of serum progesterone levels. The highest P4 concentrations were determined in autumn season (4.50±0.32 ng/ml) compared to spring (3.60±0.31 ng/ml) and winter (3.30±0.28 ng/ml) seasons. Seasonal fluctuations in serum progesterone concentrations were also reported in German Blackhead Mutton (GBM) ewes and German Mutton Merino (GMM) ewes (Kaulfuss et al., 2006). Also they found that ewes had higher ovulation rate in main breeding season (September-February) than the rest of the year. Embryonic mortality occurred in ewes that had intermediate concentrations of P4 compared to the quick response ewes and the anestrus ones, indicating the occurrence of pregnancy and that it did not have enough P4 to support such pregnancy from their CLs.

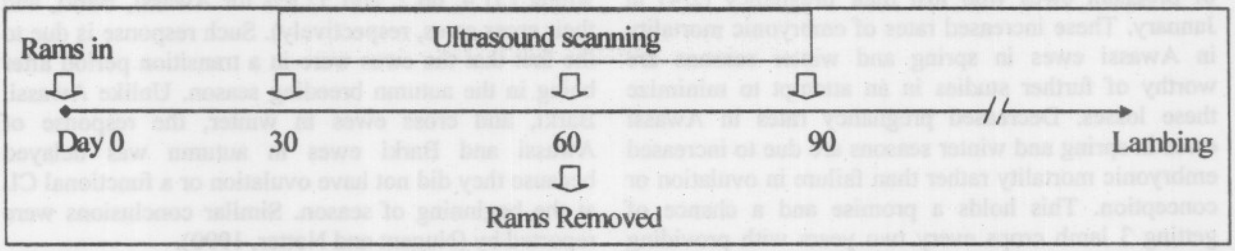

Figure (1): Matings scheme and ultrasound diagnosis of pregnancy schedule on days 30; 60 and 90 after onset of mating in Awasi ewes, Barki ewes and their crosses in three consecutive mating seasons of spring; autumn, and winter.

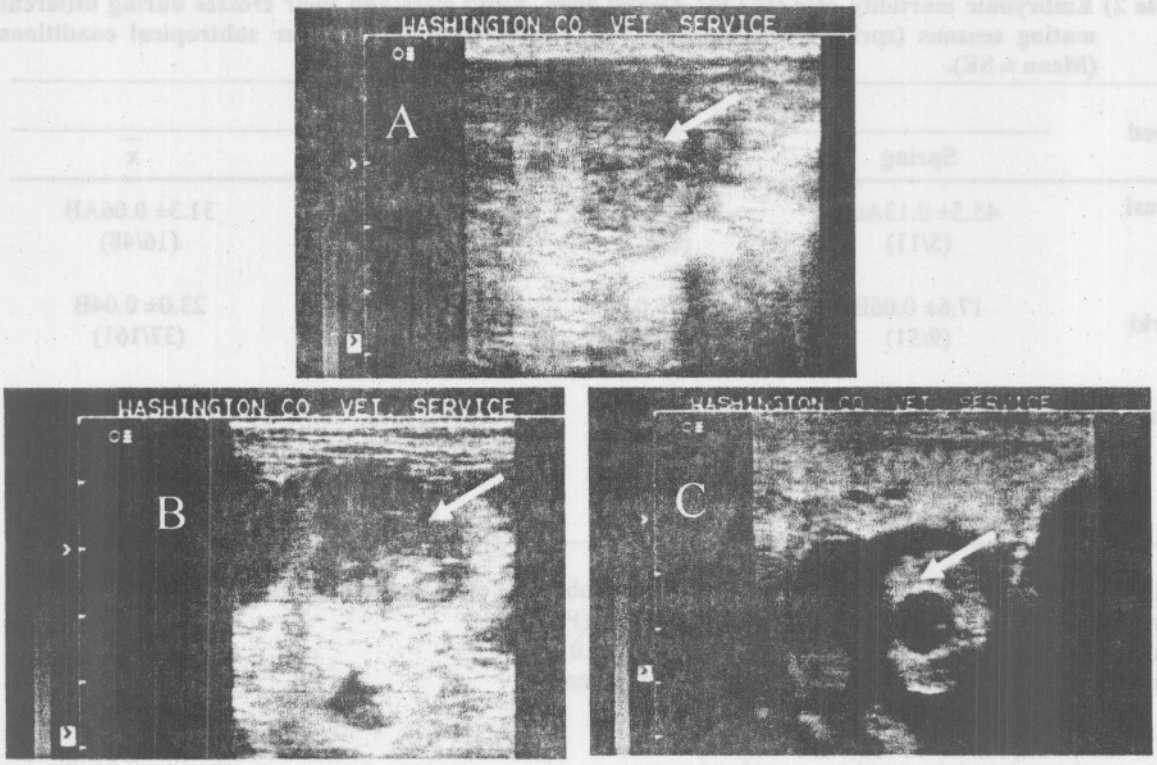

Figure (2): Ultrasonographic images of sheep uteri with arrows showing (A) an open ewe uterus with no fluid in the uterus, (B) Embryo proper and its fluids in 30 d old pregnancy, (C) a 60 d pregnancy where semi-circular placentomes are clearly visible.

(Table 1) Lambing rate (%) for Awassi ewes, Barki ewes and their crosses during different mating seasons (spring, 2005, autumn 2005, and winter, 2006) under subtropical conditions (Mean ± SE).

Breed	Seasons of mating			
	Spring	Autumn	Winter	$\bar{x}$
Awassi	16.7 ± 0.09^{Bb} (5/30)	67.6 ± 0.08^{a} (25/37)	16.7 ± 0.13^{Bb} (2/12)	40.0 ± 0.05^{B} (32/79)
Barki	61.4 ± 0.06^{A} (43/69)	69.1 ± 0.06 (47/68)	61.4 ± 0.06^{A} (35/57)	64.1 ± 0.03^{A} (125/194)
Crosses	*	58.3 ± 0.08^{a} (21/36)	26.9 ± 0.09^{Bb} (7/26)	45.2 ± 0.06^{B} (28/62)
$\bar{x}$	48.5 ± 0.05^{b} (48/99)	66.0 ± 0.04^{a} (93/141)	46.3 ± 0.05^{b} (44/95)	

Numbers in brackets represent no. of ewes lambed/total no. of ewes exposed to rams.
Means with different capital letters within columns differ ($P<0.01$).
Means with different small letters within rows differ ($P<0.01$).
*Cross ewes were not bred in spring season.

(Table 2) Embryonic mortality rate (%) for Awassi ewes, Barki ewes and their crosses during different mating seasons (spring 2005, autumn 2005, and winter 2006) under subtropical conditions (Mean ± SE).

Breed	Seasons of mating			
	Spring	Autumn	Winter	$\bar{x}$
Awasi	45.5± 0.13Aab (5/11)	24.2± 0.08b (8/33)	50.0± 0.22ABa (2/4)	31.3± 0.06AB (16/48)
Barki	17.6± 0.06B (9/51)	21.7± 0.06 (13/60)	30.0± 0.06B (15/50)	23.0± 0.04B (37/161)
Crosses	*	27.6± 0.08b (8/29)	69.6± 0.09Aa (16/23)	46.2± 0.06A (24/52)
$\bar{x}$	22.6± 0.06b (14/62)	23.8± 0.04b (29/122)	42.9± 0.05a (33/77)	

Numbers in brackets represent no. of ewes that did not lamb/no. of ewes that were diagnosed pregnant.
Means with different capital letters within columns differ (P<0.01).
Means with different small letters within rows differ (P<0.01).
*Cross (Awasi x Barki) ewes were not bred in spring season.

(Table 3) Percentages of anestrus Awassi ewes, Barki ewes and their crosses during different mating seasons (spring, 2005, autumn 2005, and winter 2006) under subtropical conditions (Mean ± SE).

Breed	Seasons of mating			
	Spring	Autumn	Winter	$\bar{x}$
Awasi	63.3 ± 0.07^{aA} (19/30)	10.8 ± 0.06^{b} (4/37)	66.7 ± 0.11^{Aa} (8/12)	39.2 ± 0.05^{A} (31/79)
Barki	25.7 ± 0.05^{aB} (18/69)	11.8 ± 0.05^{b} (8/68)	12.3 ± 0.005^{Bb} (7/57)	16.9 ± 0.03^{B} (33/194)
Crosses	*	19.4± 0.06 (7/36)	11.5 ± 0.08^{B} (3/26)	16.1 ± 0.05^{B} (10/62)
$\bar{x}$	37.0 ± 0.04^{a} (37/99)	13.5 ± 0.03^{b} (19/141)	18.9 (18/95)± 0.04^{b}	

Numbers in brackets represent no. of anestrus ewes/total no. of ewes exposed to rams.
Means with different capital letters within columns differ (P<0.01).
Means with different small letters within rows differ (P<0.01).
*Cross (Awasi x Barki) ewes were not bred in spring season.

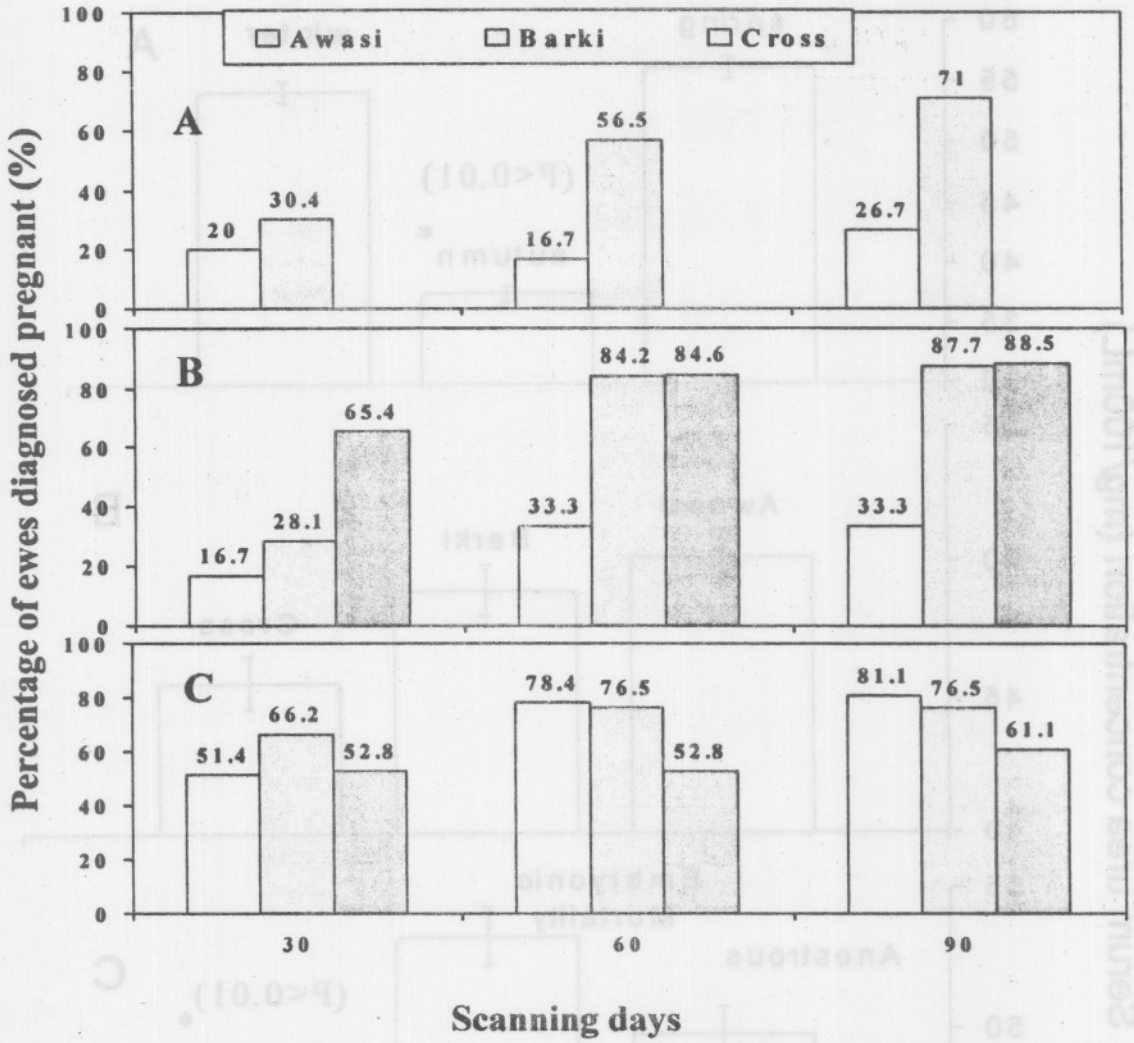

Figure (3): Pregnancy diagnosis by ultrasound scanning of uterine contents on days 30; 60 and 90 after onset of mating in Awasi ewes, Barki ewes and their crosses in three consecutive mating seasons of spring (A), autumn (B), and winter (C).

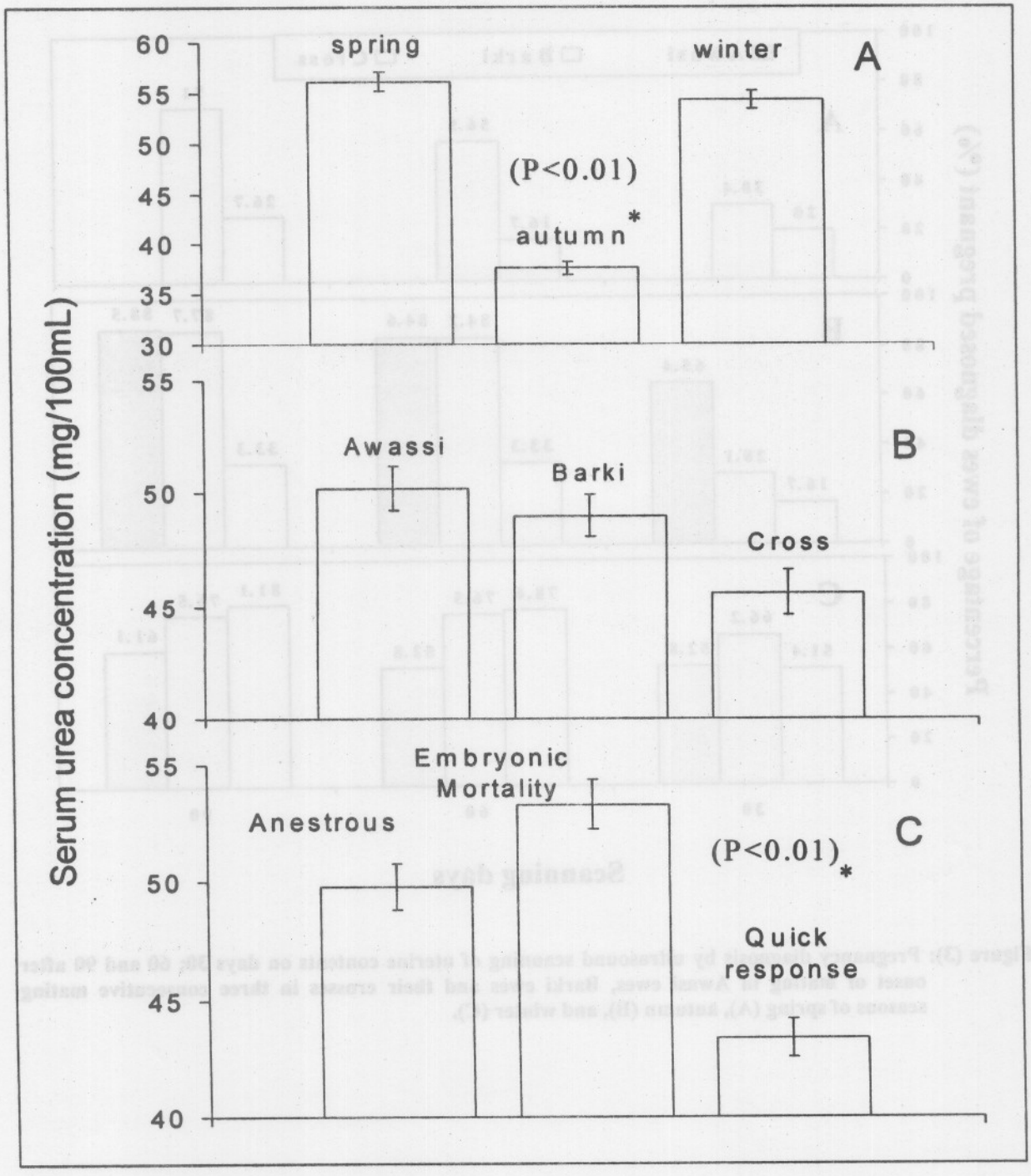

Figure (4): Changes in serum urea nitrogen as affected by (A) mating seasons, (B) breed and, (C) reproductive status of ewes.

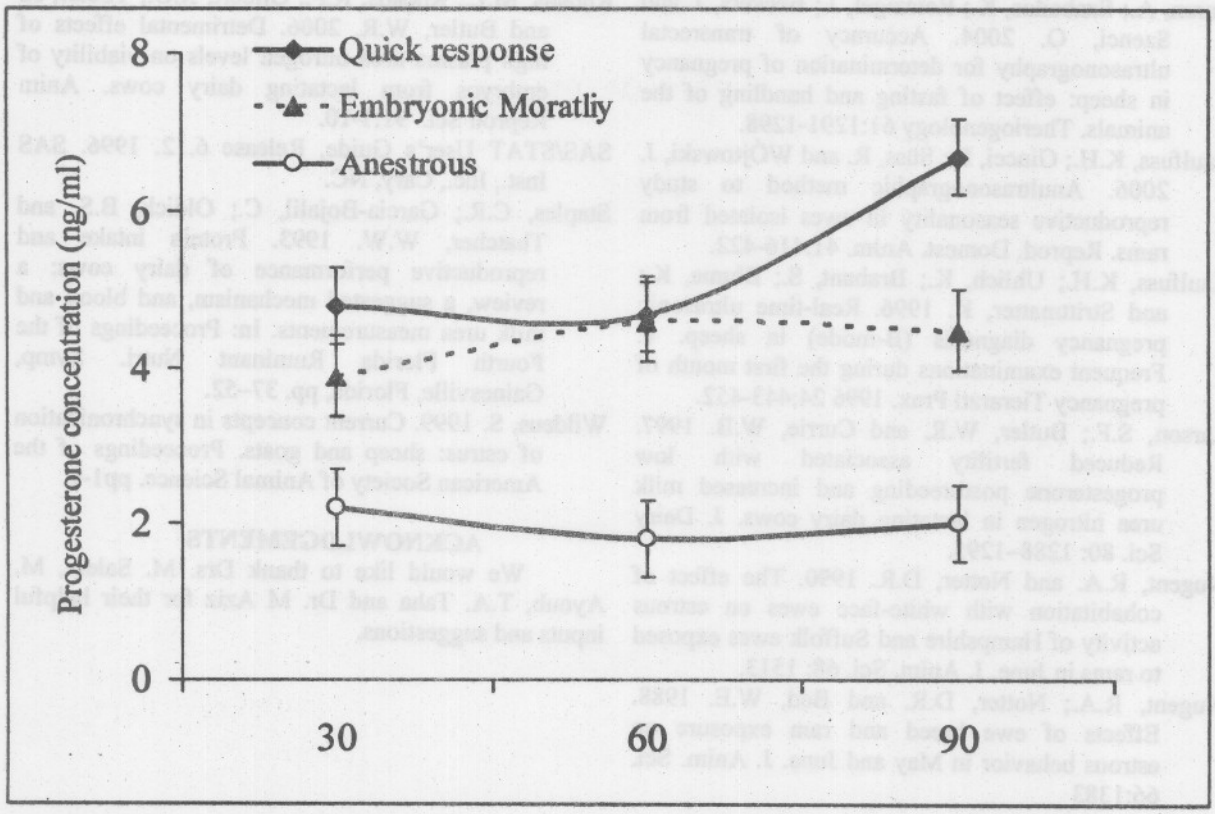

Figure (5): Concentrations of progesterone (ng/ml) in quick responding, embryonic mortality, and anestrus ewes group during scan days 30, 60 and 90 after rams' introduction.

IMPLICATIONS

The ability to early identification of non-pregnant ewes by using the transrectal ultrasonography as early as day 17 to 19 of gestations will provide producers with the opportunity to focus management efforts on non-pregnant ewes. Seasonality phenomena in sheep reproduction plays a major setback in sheep industry as it leaves breeders with narrower window of breeding time every year. The use of ultrasound technology provides the possibility of early diagnosis of pregnancy and hence rebreeding the recently-diagnosed non-pregnant ewes to fertile rams eventually before mating season is over. Moreover, the non-pregnant ewes will be detected and prepared for the following mating season. Such management of ewes will ensure efficient and most economical usage of animals and resources. Early-diagnosed pregnant ewes should be separated and fed accordingly to minimize embryonic losses. Further studies are needed to define proper means to decrease blood urea nitrogen level either through diet manipulations or by increasing efficiency of metabolism in ruminant animals particularly sheep destined to breeding.

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الملخص العربى

معدلات الولادات وفقد الأجنة فى نعاج العواسى والبرقى وخليطهما خلال ثلاث مواسم تلقيح متتالية فى منطقة الساحل الشمالى الغربى بجمهورية مصر العربية

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أجريت هذه الدراسة لهدف معرفة ما إذا كان التشخيص المبكر للنعاج الحوامل بإستخدام الموجات فوق الصوتية (السونار) ثم الإبقاء على الكباش مع النعاج غير الحوامل لمدة دورتين شياع أخريين يؤدى إلى زيادة معدلات الحمل ومن ثم زيادة محصول الحملان . تم إدخال الكباش المخصبة إلى نعاج العواسى والبرقى وخليطهما لمدة ٣٠ يوماً فى ثلاث مواسم متتالية: الربيع (٣٠عواسى ، ٦٩ برقى)، الخريف (٣٧عواسى، ٦٨ برقى، ٣٦ خليط)، الشتاء (١٢عواسى، ٥٧ برقى، ٢٦ خليط). تم تشخيص الحمل بإستخدام السونار عبر المستقيم بعد ٣٠ يوماً من دخول الكباش وفصلت النعاج الحوامل وإستمرت الكباش مع النعاج غير الحوامل لمدة ٣٠ يوماً أخرى. فى موسم الربيع أعطت نعاج البرقى معدل ولادات أعلى من العواسى ($p<0.01$) بينما فى موسم الخريف كل السلالات أعطت معدلات متماثلة من الولادات بمتوسطات ٦٧,٦ % ،٦٩,١% ،٥٨,٣% لنعاج العواسى والبرقى والخليط على التوالى. وفى موسم الشتاء أعطت نعاج البرقى معدل ولادات أعلى (٦١,٤%) مقارنة بنعاج العواسى (١٦,٧%) . معدل فقد الأجنة فى نعاج العواسى (٤٥,٥%) كان أعلى من نعاج البرقى (١٧,٣%) وذلك فى موسم الربيع، بينما فى موسم الخريف فإن كل النعاج كان لها معدل فقد أجنة مقبول ومتماثل فى كل السلالات. فى موسم الشتاء أعطت النعاج الخليطة أعلى معدل لفقد الأجنة (٦٩,٦%) مقارنة بنعاج البرقى (٣٣,٠%) ونعاج العواسى (٥٠,٠ %).

نعاج العواسى أظهرت أعلى معدل خمول جنسى فى موسمى الربيع (٦٣,٣%) و الشتاء (٦٦,٧%) مقارنة بموسم الخريف (١٠,٨%). نعاج البرقى أظهرت أعلى معدل خمول جنسى لها فى موسم الربيع(٢٥,٧%) مقارنة بـ ١١,٨% فى موسم الخريف و ١٢,٣% فى موسم الشتاء. أظهرت تحاليل الدم ارتفاع تركيز اليوريا فى سيرم النعاج الخاملة جنسياً و تلك التى فقدت أجنتها مقارنةً بالنعاج السريعة الأستجابة. كما اظهرت التحاليل انخفاضاً فى تركيز هرمون البروجسترون فى النعاج الخاملة جنسياً عن تلك التى فقدت أجنتها و النعاج سريعة الأستجابة التى أظهرت أعلى مستويات إفراز للبروجسترون على مدار الدراسة.

الكلمات الدالة: الموجات فوق الصوتية (السونار) ، معدل الولادات ، فقد الأجنة ، الأغنام، اليوريا، البروجسترون