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Some studies on the reproductive performance in small ruminants

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ABSTRACT

The current study entails the data obtained from ultrasonography investigation of the reproductive statuses of ewe (n=232) and does (n=164) admitted to Meet Kenana, Veterinary Clinic, Tukh, Qalyubia governorate aiming to declare the contributing factors (species, season, body weight and age) impact their fertility. Pregnancy examination revealed higher rate of singleton pregnancy in ewes, while multiple pregnancy was higher in does. A higher incidence of pregnancy was recorded during winter season (46.74%; 86/184), but lower pregnancy rate was recorded during summer season (5.98%; 11/184). In cyclic animals, a high incidence of follicular phase was recorded during spring season (43.22%), while luteal phase was high in winter (68.18%). On the other hand, in non-pregnant animals diagnosed to have inactive ovaries, higher incidence was recorded in ewe (10.34%; 24/232;) than does (6.70%; 11/164). On the other hand, uterine disorders at high incidence were recorded in in does (9.75%; 16/164) than ewe (6.46%; 15/232). Summer season was associated with high rate of inactive ovaries (62.85%), while spring season was accompanied with high incidence of uterine disorders (70.96). Ewes at 60-70 kg body weight and 4-5 years old, and does at 40-50 kg body weight and 2-3 years old showed an improved reproductive index (cyclicity and pregnancy rates). From the present study it could be concluded that the ultrasound is a promising diagnostic tool helps in improving the reproductive management of small ruminants through verifying the pregnant status, selection of fertile cyclic animals before breeding, and discarding the protracted infertile cases.

1. INTRODUCTION

Small ruminants (Sheep and she-goats) productive and reproductive performances face a great challenge in Egypt due to difficulty in the diagnosis of the animals' reproductive status. The use of modern diagnostic approaches as ultrasonography, molecular testing…etc. could be promising in manipulating this important issue. The availability of a non-invasive, rapid and accurate diagnostic tool like ultrasonography would guide the farmers in their decisions to replace the infertile animals and increase their care with pregnant animals.

Egyptian sheep and goat populations are about 5,552,849 and 4,063,208 heads, respectively (FAOSTAT, 2018). They contribute about 60 % of total red meat production and also wool production as secondary product (Mahfouz et al., 2008). They have the ability to adapt various environmental condition including different temperature and feed (Galal et al., 2005). However, small ruminant population are decreasing and becoming quite insufficient to meet the increasing market demands for their products. Therefore, an improvement of small ruminants' reproductive performance and prolificacy has more economic impacts than improving growth rate (Galal et al., 2005).

In Egypt, most sheep producers are resource-poor farmers with low income and education levels compared with other farm animal producers. Feed costs and the insufficiency of feed resources, and other costs such as transportation and water result in many producers selling part of their flocks in order to be able to feed the remaining animals (Hailat et al., 2005). Nevertheless, many sheep farmers are continuously attempting to improve ewe productivity in Egypt by selection and mating the superior males and females in their flocks and reducing lamb loss by controlling diseases causing infertility, abortion and neonatal deaths.

The utilization of an accurate and easily applicable method for pregnancy diagnosis allows the timely repeated insemination, breeding or culling of non-pregnant animals (Amer, 2010). Accurate information on the stage of gestation would be useful to dry off lactating females at adequate period and to monitor the females near term (Doize et al., 1997).

Predictions of the number of fetuses would allow appropriate nutritional management of females in late gestation that will prevent pregnancy toxemia (Ford, 1983), minimize pre-lambing feeding costs, optimize birth weight, weaning weight and survivability of lambs and reduce incidence of dystocia.

Ultrasonography facilitates an enhancement of the reproductive management in farms and improves the commerce of pregnant animals (Santos et al., 2004). It helps livestock producers for making culling/rebreeding decisions, for food allotment, and for clinical and research purposes. Ultrasound is not only used for evaluation of the ovarian functions and/or disorders, but also used to monitor uterine pathophysiology, early pregnancy diagnosis (Beal et al., 1992), embryo/fetal development (Pierson et al., 1987), fetal sexing and prediction of the expected date of parturition

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(Wright et al., 1988). Moreover, it is applicable for assessing uterine pathology e.g., endometritis, pyometra, uterine fibrosis and early embryonic/ fetal death. Besides, it helps in clarifying the efficacy of treatment regimens (Griffin et al., 1992).

The present study aimed to survey the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) in ewe and does in Qalyubia governorate and to evaluate the contributing factors affecting it (season, age, and weight) using ultrasonographic examination.

2. MATERIAL AND METHODS

2.1. Animals

The present study as carried out on a total number of 232 Baladi ewe and 164 does under field condition of Qalyubia governorate in Egypt during the period from December 2018 to December 2019. All animals were admitted to Meet Kenana, veterinary clinic Tukh, Qalyubia governorate for pregnancy diagnosis.

2.2. Animals weight determination

Ewe and does' weight were determined using tailor tape depending on measuring of animal's heart girth according to Moaeen-ud-Din et al. (2006) and applying the following formula: Animal body weight (in Pounds) =HG × HG × BL ÷ 300. Animal body weight (in KG) = Weight in pounds × 0.4536

2.3. Animal age determination

Ewe and does aging was determined using the dental formula according to Ridler (2010) in ewe and Eubanks (2012) in does

2.4. Ultrasonographic examination

Ultrasonographic examination of ewe and does was performed transrectally and/or transabdominally using a real time B- mode scanner equipped with 3-8 MHz transducer (Sonoscape MA5 Vet., China) according to Kandiel et al. (2008).

For transrectal examination, animals were restrained in a standing position and the well lubricated ultrasound transducer was preceded through the rectum until the urinary bladder and the uterine horns were imaged.

For transabdominal examination, the animals were restrained horizontally on one side on a table. An area of 20-40 cm around the udder was clipped and both sides of the abdomen have been scanned. The area over which the transducer was moved extended across the width of the abdomen, passing from one side of the udder, across in front of the udder, to the other side (Kandiel et al., 2015). Depending on the stage of gestation, pregnancy diagnosis was based on recognition of fluid filled uterus, placentomes, fetal structures, such as head, thorax, and limbs and fetal body movements.

2.5. Statistical analysis

All data were statistically analyzed using SPSS (2019; Ver. 23) according to Feldman et al. (2003). The incidence of various reproductive conditions was statistically analyzed using *chi*-square (X^2) test. The data were graphically presented using Microsoft Office-Excel application. *P* values < 0.05 were considered as statistically significant.

3. RESULTS

3.1. Effect of animal species (Ewe vs. does) on the incidence of reproductive statuses under field conditions of Qalyubia Governorate

Data regarding the influence of species on the distribution of various reproductive statuses is presented in figs. (1 & 2), and its statistical analysis is shown in table (1). The incidence of ewe showed normal cyclicity, infertility and pregnancy were: 35.34%, 17.24% and 47.41%. In the meantime, the corresponding values in does were 35.36%, 19.51% and 45.12%, respectively. Some of the examined ewe (n=1) and does (n=5) showed mixed ovarian and uterine problems. Chi square analysis showed that the incidence cyclicity, reproductive disorders or pregnancy in ewe and does did not reach to a statistically significant level (P=0.27). However, the rate of ovarian disorders was numerically higher in ewe than does, while the rate of uterine disorder were numerically higher in does than ewe. The rate of singleton pregnancy was higher in ewe, but multiple pregnancy was higher in does (P< 0.0001).

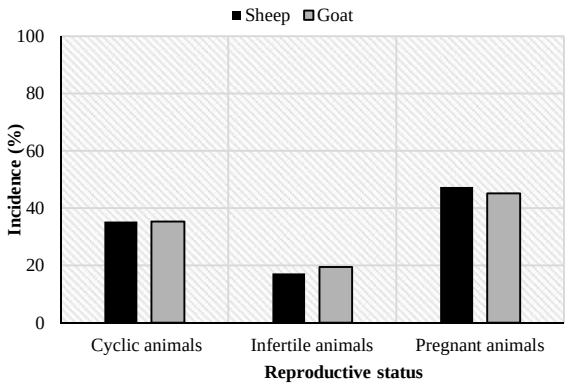

Fig. 1. Distribution of the reproductive conditions in ewe (■) and does (■) under investigation.

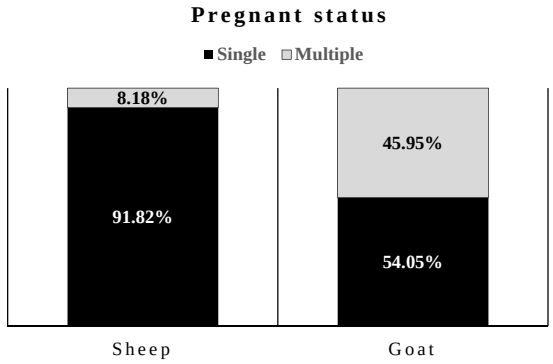

Fig. 2 Distribution of pregnancy status (single vs. multiple) in ewe and does under investigation.

Table 1. Chi square statistical analysis of the incidence of some reproductive statuses and pregnancy (single vs. multiple pregnancy) in ewe vs. does.

	Reproductive status	Pregnancy status
χ^2 value	5.21	30.31
P value	0.27	< .00001
Interpretation	The result is not significant at p <0.05.	The result is significant at p < 0.05.

3.2. Effect of season on small ruminant's reproductive status
Data regarding the influence of season on the distribution of various reproductive statuses in examined small ruminants (ewe and does) is presented table (2). There was significant (P< 0.05) impact of the season on the incidence of reproductive statuses0. The highest incidence of follicular and luteal phases was recorded during spring and winter seasons (43.22% and 68.18 %, respectively). The highest incidence of inactive ovaries and uterine disorders was recorded during summer and spring seasons (62.85% and 70.96%, respectively). The pregnancy rate upsurge during winter (46.74%) but reach to minimal values (5.98%) during summer.

3.3. Effect of body weight on the incidence of reproductive statuses
The influence of body weight on the distribution of various reproductive statuses in ewe and does is presented in tables 3.1 (Ewe data) and 3.2 (does data).
Chi- square analysis of the incidence of reproductive conditions in small ruminants showed that the incidence rates varied in ewe (P=0.07) and does (P<0.05) according to their body weight. Ewe at 60-70 kg b. wt. and does of 40-50 kg b. wt. were the most expressing normal cyclicity and pregnancy rates, but at the same time the most encountered reproductive problems.

3.4. Effect of animal age on the incidence of reproductive statuses
Data regarding the influence of female age on the distribution of various reproductive statuses is presented in tables 4.1 (Ewe data) and 4.2 (does data).
Statistical analysis of the incidence of reproductive conditions in small ruminants by Chi- square test showed that the incidence rates varied in significantly in ewe (P< 0.001) and does (P< 0.005) with the age. In ewe, an age of 4-5 years though showed the highest incidence of follicular and luteal phases, it is also associated with inactive ovaries and uterine disorders. On the other hand, the pregnancy rate was the highest at 3-4 years old. In does, follicular phase and uterine disorders was the highest at 2-3 years old. The luteal phase was the highest at 4-5 years old (30%; 3/10). Inactive ovaries were high in young animals up to 2 years old (45%; 5/11). Pregnancy rate was very high at an age of 3-4 years old (49%; 36/74).

4. DISCUSSION

Data concerning of the effect of species on the reproductive condition showed that ewe had a higher incidence of inactive ovaries and singleton, but lower incidence of uterine disorders than does. The differences in the ovarian activity and number of feti per pregnancy in ewe compared to does reported in the present study might be due lower estradiol production by the follicles in association with high leptin levels inhibiting steroidogenesis in ewes (Vinoles et al., 2005). They also recorded the lower estradiol concentrations and the lower circulating FSH concentrations through positive feedback mechanism at the level of the hypothalamus and pituitary gland. On the other hand, lower incidence of uterine disorders in ewe than does in the current study came in accordance with Purohit et al. (2006), who recorded a lower incidence of parturition related disorders in ewe compared to does. Similarly, previous reports showed that the incidence of hydrometra or pseudopregnancy was lower than does (Wittek et al., 1998).

Table 2. Effect of season on the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) of small ruminants under investigation

Season	**The incidence of reproductive condition (%)**						***Chi* square analysis**	
	Pregnancy	**Cyclic animals**		**Infertile animals**				
		Follicular Phase	*Luteal Phase*	*Inactive ovary*	*Uterine problems*	*Mixed uterine & ovarian*	χ^2 *value*	*P value*
	(n=184)	(n=118)	(n=22)	(n=35)	(n=31)	(n=6)		
Winter	46.74	33.05	68.18	2.85	9.67	16.66	185.95	<0.00001
Spring	23.91	43.22	27.27	5.71	70.96	0.00		
Summer	5.98	4.23	4.54	62.85	0.00	83.33		
Autumn	23.37	19.49	0.00	28.57	19.35	0.00		

Table 3.1. Effect of body weight on the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) of ewe under field conditions

Animal groups according to the body weight (kg)	The incidence of reproductive condition (%)						*Chi* square analysis	
	Pregnancy	Cyclic animal		Infertile animal				
		Follicular phase	*Luteal phase*	*Inactive ovary*	*Uterine problem*	*Mixed uterine & ovarian*	χ^2 *value*	*P value*
	(n=110)	(n=70)	(n=12)	(n=24)	(n=15)	(n=1)		
< 50 kg	4.54	5.71	8.33	16.67	0	0	19.84	0.07
50-60 kg	39.1	35.71	41.67	16.67	0.2	0		
60-70 kg	46.36	52.85	50	50	0.8	100		
> 70 kg	0.1	10	0	16.67	0	0		

Table 3.2. Effect of body weight on the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) of does under field conditions

Animal groups according to the body weight (kg)	The incidence of reproductive condition (%)						*Chi square analysis*	
	Pregnancy	Cyclic animal		Infertile animal				
		Follicular phase	*Luteal phase*	*Inactive ovary*	*Uterine problem*	*Mixed uterine & ovarian*	*χ2 value*	*P value*
	(n=74)	(n=48)	(n=10)	(n=11)	(n=16)	(n=5)		
< 40 kg	10.81	25.00	10.00	36.36	37.50	40	16.7	0.03
40-50 kg	66.2	39.58	60.00	36.36	62.50	40		
> 50 kg	22.97	35.42	30.00	27.27	0.00	20		

Table 4.1. Effect of age on the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) of ewe under field conditions

Animal groups according to the age (year; Y)	The incidence of reproductive condition (%)						*Chi* square analysis	
	Pregnancy	Cyclic animal			Infertile animal			
		Follicular phase	*Luteal phase*	*Inactive ovary*	*Uterine problem*	*Mixed uterine & ovarian*	χ^2 *value*	*P value*
	(n=110)	(n=70)	(n=12)	(n=24)	(n=15)	(n=1)		
< 2 Y	17.27	14.28	8.33	16.66	0.00	0.00		
2-3 Y	30.91	15.71	16.67	16.66	6.66	0.00		
3-4 Y	32.72	21.42	25.00	12.50	33.33	0.00	39.21	0.001
4-5 Y	11.82	31.42	50.00	29.16	33.33	0.00		
> 5 Y	7.27	17.14	0.00	25.00	26.67	100		

Table 2.4.2. Effect of age on the incidence of some reproductive statuses (pregnancy, cyclicity and infertility) of does under field conditions

Animal groups according to the age (year; Y)	The incidence of reproductive condition (%)						*Chi* square analysis	
	Pregnancy	Cyclic animal			Infertile animal			
		Follicular phase	*Luteal phase*	*Inactive ovary*	*Uterine problem*	*Mixed uterine & ovarian*	χ^2 *value*	*P value*
	(n=74)	(n=48)	(n=10)	(n=11)	(n=16)	(n=5)		
< 2 Y	8.11	12.5	20.00	54.54	31.25	40.00		
2-3 Y	24.32	27.08	20.00	18.18	43.75	40.00		
3-4 Y	48.65	25.00	20.00	9.09	12.50	20.00	35.97	0.003
4-5 Y	13.51	25.00	30.00	9.09	6.25	0.00		
> 5 Y	5.41	10.41	10.00	18.18	6.25	0.00		

Hydrometra incidence was 2.9% in ewes (Bretzlaff, 1993), while its incidence ranged from 3-5 % (Mehta et al., 2002) and up to 14.3% (Purohit et al., 2006) in does. Accordingly, the post-parturient metritis was more encountered in does than ewe specially with those exhibited is a previous retained placenta or uterine inertia (Purohit et al., 2006).

Data concerning of the effect of season on the reproductive condition in the examined small ruminants verified that the winter season had the highest incidence of pregnancy, while summer had the highest incidence of reproductive problems (inactive ovaries and uterine disorders). In natural conditions, seasonality, which is mediated by photoperiod, modifies hormonal balance and causes seasonal reproductive variations in ewe (Karsch, et al. 1984), giving rise to a decrease in reproductive activity during long days (anestrous season). In contrary, Abdel- Gawad (1996) reported higher conception rate in Rahmani ewes in summer (81.6-91.5%) than winter (69.8-83.2%). The differences might be due to the condition of feeding and animal breeds.

Regarding the effect of body weight on the reproductive status of small ruminants, the current data showed that ewe had the highest pregnancy rate in ewe and does was at body weight 60-70 kg and 40-50 kg, respectively. Former studies applied ultrasonography for studying the static effect of nutrition on daily follicular development, found that an increased ovulation rate in ewes with high body condition in association with the increase in FSH and decrease estradiol concentrations (Vinoles et al., 2002). Moreover, Gamez et al. (2008) demonstrated that BCS of does passivity affected serum leptin concentration in a direct and proportional way, the better the BCS the greater serum leptin concentration during seasonal period. Positive relationship has been shown between BCS and plasma leptin and FSH concentrations in Iranian fat tail ewes at mating time (Towhidi et al., 2007). Also, Vinoles et al. (2005) indicated that lower estradiol production by the follicles is most probably associated with the higher leptin levels inhibiting steroidogenesis in ewes in high body condition. The lower estradiol concentrations reduce negative feedback at the hypothalamus and pituitary gland, leading to higher circulating FSH concentrations. The pool of follicles available for the action of glucose and metabolic hormones may play a key role in stimulating an increase in ovulation rate. Ewes in high body condition had a higher number of gonadotrophin dependent follicles than did ewes in low body condition (Vinoles et al., 2005). Ewes with very high level of body condition score show an increase in ova wastage and reduce in reproductive performance (Rhind et al., 1985). They also recorded that the Low body condition is related to the prevention of estrus and fertility. These findings closely agreed with Mabrouk (1970), who declared that heavy ewes exhibited higher conception rate than lighter ones. Also, Kenyon et al. (2004) presented that the rate of ewes mated tend to increase with the increase in their body weight. It might be expected that ewes of lower body weight and BCS will display reduced reproductive performance in comparison with those of greater ones. The end point from a reproductive perspective for farmers is often the numbers of lambs weaned per ewe presented for breeding. Smith (1991) suggested a curvilinear relationship (instead of linear) between live weight and ovulation rate i.e. for each additional increase in the live weight, the relative improvement in ovulation rate decreases. Furthermore, overweight ewes are less likely to respond, in terms of an increase in ovulation rate, to improved levels of nutrition prior to breeding (Smith, 1991). However, the current findings disagreed with Abegaz et al. (2002), who showed that the lambing rate and live body weight of ewes were higher (90.6%) in the ewes weighing 33-42 kg than those weighing > 42 kg (84.6%) or 22-32 kg (73.8%). Nevertheless, Ozturk. (2000) claimed that live body weight at mating did not affect lambing rate in Konya Merino ewes.

Data concerning of the effect of age on the reproductive condition declared an improvement in the pregnancy rate at the age of 3-4 years, and an increment in the rate of infertility problems (inactive ovaries and uterine disorders) in those less than 3-4 old. These findings closely agreed with (Mabrouk, 1970), who stated that the lambing rate in ewes increased with age of ewes and reached its maximum at 4-5 years. In this respect, Esmaeili-Zadeh et al. (2004) reported that the conception rate increased with the increase in ewes age of ewes, and the lowest conception rate was noted in ewes at 1.5 years old.

5. CONCULOSIONS

From the present study it could be concluded that under the local Egyptian conditions, the reproductive potential of ewe and does reared on small scale basis by farmers is subjected to the influence of season, body weight and age as detected through of ultrasonographic examination. Additionally, the use of ultrasound in small ruminants is an efficient tool aid in improving their reproductive management and increase the fertility life of them through diagnosing the pregnant status, selection of fertile animals before breeding and discarding the long-standing incurable infertile cases.

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