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Studies on some biochemical markers of Ouled Djellal ewes from semi-arid zone

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Abstract

The purpose of this study was to determine the influence of physiological stages and seasons on some blood markers of Ouled Djellal breed from semi-arid zone of east Algeria. The study was conducted on healthy ewes during winter and spring, divided into getationals and lactating females. The concentrations of plasma glucose, cholesterol, triglycerides, urea and creatinine were determined. The levels of glucose, cholesterol and triglycerides have not showed any significant difference between gestationals and lactating females during winter as well as during spring. However, urea and creatinine levels showed significant differences between gestational and lactating females in spring. Concerning the seasons, results indicate higher concentrations of cholesterol and creatinine of gestational females as well as urea level of lactating ewes in spring compared to winter. To conclude, the physiological stages has influenced urea and creatinine concentration, while spring has increased cholesterol, creatinine and urea level.

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Introduction

The sheep production system in Algeria is a fundamental element of the economy, particularly in the steppes and semi-arid high plains, where they are particularly adapted to the natural environment and to diversified pastoral resources (Kerboua *et al*., 2003). In fact, sheep meat is traditionally the most appreciated especially during the various festivals (Abdelguerfi and Ramdane, 2003), it represents 40% of the production of red meat (Itelv, 2000). Adem (1986) and Chellig (1992) reported that the sheep flock, the leading supplier of red meat in Algeria, is dominated by three main breeds; Ouled Djellal, El Hamra and Beni Ighil, which are well adapted to the factors of the environment.

The Ouled Djellal is the largest breed in Algeria with about 63% of the total sheep population, distributed particularly in the East and in the center of the country. It is an excellent meat producer (Chellig, 1992), typical of the steppe and the high plains and the most adapted to the nomadism. Ouled Djellal is an entirely white race with fine tail, high waist, long legs and suitable for walking. It has a recognized production skill, where it promotes better nutrition with faster growth rates and higher weight gains.

The energy requirements of animals vary with various factors such as age, sex, live weight, body condition, physiological status, environmental conditions, physical activity and genetic characteristics. (Caldeira *et al*., 2007). Energy intake is by far the most critical dietary factor affecting the health, lactation and reproduction of animals. Certain serum markers are useful in assessing the energy status and growth of animals such as glucose, triglycerides, cholesterol, urea and creatinine.

Some studies have been carried out on Ouled Djellel breed concerning its dominance on the Algerian territory, its morphological characteristics (Kerboua *et al*., 2003, Aissaoui *et al*., 2004, Ghozlane *et al*., 2005, Benaissa, 2001; Belacel 1991, Dekhili and Mahane 2004, Harkat and Lafri 2007) and genetic variability (Fadlaoui 2006, Benyoucef *et al* 1995).

Moreover, lipid and carbohydrate profiles (Hamadeh *et al*., 1996, Abdelrahman *et al*., 2002, El Sherif and Assad, 2001, Nazifi *et al*., 2002, Titaouine, (2015), in addition to the nutritional need (Tabouche 1985; Abaab *et al*., 1995; Mamine, 2010) and reproduction process were investigated on Ouled Djellal breed (Abbas *et al*., 2002, Dekhili and Aggoun, 2005).

The objective of this work is to evaluate certain biochemical markers related to the energetic and nutritional status of Ouled Djellal breed at two physiological status during the winter; where there is a relative reduction in temperature and food, and during the spring where weather and the nutritional conditions are much more favorable.

Materials and methods

The study location

The study was carried out on a pilot farm covering 374 hectares (Fig 2), located in the North-East of Algeria (36°17'11 "N, 7°57'4" E). Ewes were feed mainly on natural pasture, straw, in addition to dry and green barley (FPYT, 2016). However, 40 ewes of Ouled Djellal breed (aged between 15-24 months) during the winter and springs were randomly selected. Ewes were then divided into 02 physiological stages; lactatings (20) and gestational females (20).

Samples' collection

Blood samples were taken by puncture of the jugular vein at 9am; before food intake in heparinized tubes, and then centrifuged at 1500g for 10 minutes at 4°C. The plasma was stored at -20°C until analyzed. The biochemical markers (glycemia, cholesterol, triglycerides, urea, creatinine) were determined.

Statistical analysis

Statistical analysis of the data was performed using the Minitab software (version 17). Results are subjected to a one-way ANOVA analysis, to determine the effect of physiological stages and season on the markers considered. Results are described as mean ± standard deviation. The differences were considered significant at $p < 0.05$.

Fig 1. Location of the study site..

Results and discussion

Comparison between the physiological stages

The comparison between two physiological stages of females throughout the same season was presented in Tables 1-5.

Table 1. Variations of plasma glucose (g/l) of Ouled djellal during two physiological stages.

Glucose		Mean ± SD	*p*
Physiological stage	Gestationals in winter	0.677± 0.040	NS
	Lactatings in winter	0.595 ± 0.76	
	Gestationals in spring	0.62 ± 0.410	NS
	Lactatings in spring	0.577 ± 0.115	

Table 2. Variations of plasma cholesterol (g/l) of Ouled djellal during two physiological stages.

Cholesterol		Mean ± SD	*p*
Physiological stage	Gestationals in winter	0.48± 0.092	NS
	Lactatings in winter	0.472 ± 0.111	
	Gestationals in spring	0.643 ± 0.124	NS
	Lactatings in spring	0.549 ±0.095	

Table 3. Variations of plasma triglycerides (g/l) of Ouled djellal during two physiological stages.

Triglycerides		Mean ± SD	*p*
Physiological stage	Gestationals in winter	0.364 ± 0.069	NS
	Lactatings in winter	0.319 ± 0.055	
	Gestationals in spring	0.393 ± 0.025	NS
	Lactatings in spring	0.341 ±0.089	

Table 4. Variations of plasma urea (g/l) of Ouled djellal during two physiological stages.

Urea		Mean ± SD	Observation *p*
Physiological stage	Gestationals in winter	0.224 ± 0.040	NS
	Lactatings in winter	0.245 ± 0.071	S
	Gestationals in spring	0.257 ± 0.067	
	Lactatings in spring	0.368 ±0.145	

S : significant at p<0,05.

Table 5. Variations of plasma creatinine (mg/l) of Ouled djellal during two physiological stages.

Creatinine		Mean ± SD	*p*
Physiological stage	Gestationals in winter	9.697± 0.752	NS
	Lactatings in winter	9.562 ± 0.982	S
	Gestationals in spring	11.046 ± 0.791	
	Lactatings in spring	9.723 ± 1.022	

S : significant at p<0,05.

Glucose level has decreased slightly during both physiological states. The reduction in blood glucose during pregnancy is thought to be due to increased permeability and to the use of maternal glucose by the fetus (Sahlu *et al.*, 1995). On their part, Castillo *et al.* (1999) noted a significant decrease in blood glucose, which appears on the 90th day of gestation, with a notable increase at the end of this stage. About 60% of fetal growth occurs during the last 6 weeks of gestation (Radostits *et al.*, 2000), this rapid

development of fetuses requires large energy intakes that the mother should meet (Hamadeh *et al.*, 1996). The development of gestational insulin resistance seems to be the key factor in this adaptation, in which the use of glucose by adipose and muscle tissue is reduced in favor of the uterus and placenta (Husted *et al.*, 2008). An adaptive increase in insulin secretion is normally observed by half at the end of gestation in sheep and rats (Osgerby *et al.*, 2002), this enhancement may be attributed to the proliferation of pancreatic β cells (Husted *et al.*, 2008).

Cholesterol concentration did not reveal any remarkable differences between the two physiological stages. Plasma cholesterol levels for both physiological stages are within physiological ranges (Bouzenzana 2015, Degnouche 2011a). It should be noted, however, that pregnant women have similar cholesterol levels to those of lactating ewes. In ruminants, serum cholesterol levels are modified by various factors, such as diet composition, age, sex, race, season, pregnancy, lactation, and liver disease (Ozpinard et Firat, 2003). In addition, Hamadeh *et al.* (1996) and Al-Dewachi (1999) reported elevated cholesterol levels in pregnant ewes relative to suckling ewes. Thus, increasing values of serum cholesterol lead to increased progesterone concentrations during the luteal phase (Ozpinar *et al.*, 1995).

The actual results agree with those described by Deghnouche *et al.* (2011b) who confirmed that pregnant ewes have elevated cholesterol levels compared to lactating ewes, and partially inconsistent with those of Yokus *et al.* (2006) who showed a significant decrease in this parameter in ewes at the end of gestation and early lactation. Therefore, the physiological stage (gestation, lactation) did not induce a significant variation of the cholesterolemia in the ewes of Ouled Djellal.

Triglycerides level of this study are in the physiological norms cited by Titaouine, (2015) in the sheep of the Ouled Djellal breed. In our study, a low decrease in triglyceride levels in lactating ewes compared to pregnant ewes was observed. This reduction may be due to the increase in tissue resistance to insulin action during this period (Yokus *et al.*, 2006), recalling that the downward trend of triglycerides and total cholesterol in early lactation has also been reported in dairy cows due to increased energy requirements during this phase (Marcos *et al.*, 1990). The decrease in serum triglycerides postpartum can be explained by the effect of the decrease in lipogenesis and the elevation in lipolysis of mammary gland that is hormone-regulated and not the expression of a lack of energy (Holtenius and Hjort (1990). Gonzalez-Garcia *et al.* (2015) showed that the plasma concentration of triglycerides falls sharply after lambing; this decrease is compatible with an increase in energy requirements and a negative energy balance (Antanovic *et al.*, 2011b). In contrast to our results, Marton *et al.* (2007) reported an increase in blood triglyceride level of ewes during lactation. These same authors affirm that with the advancement of lactation, milk production decreases as well as that of fat synthesis. It can be concluded that the physiological stages of pregnancy and lactation do not have a significant influence on the triglyceridemia level in Ouled Djellal ewes.

Uremia values in both physiologic stages are within the reported reference ranges (Ramos *et al.*, 1994, Radostits *et al.*, 2000). The most important uremia is obtained in lactating ewes. This result is shared by Karapehlivan *et al.* (2007) who found that the latter increases with the progression of lactation and can be decreased during the dry period, which is similar to our results.

The present results do not agree with those of West (1996); Soliman (2014), who reported increased uremia in pregnant ewes than in empty or lactating ewes. El Sherif and Assad (2001) found that uremia begins to increase from the 10th week of gestation to maximum concentration at parturition, this has been attributed in domestic ruminants to the catabolism of body protein stimulated by cortisol (Silanikove, 2000). However, Brozostowski *et al.* (1996) found that the increase in urea is marked early in pregnancy, and low levels occur near the end of this important period.

This study shows a significant increase in plasma urea concentration during lactation, compared with the gestational period. However, in pregnant ewes, the uremia is the lowest. Our results are comparable with those reported by Deghnouche *et al.* (2011b); Antanović *et al.* (2011a), and is different from those of West (1996); Piccione *et al.* (2009), who reported increased uremia in pregnant than in empty or lactating ewes.

This increase in uremia during lactation is justified by the arisen catabolism of muscle proteins when large amounts of body reserves are mobilized (Caldeira *et al.*, 2007), It may also be due to decreased glomerular filtration and reduced clearance of urea during late pregnancy and lactation. (Rodriguez *et al.*, 1996).

Creatinemia of the actual study showed the highest values in pregnant compared to breastfeeding ewes. This result is in agreement with that of Meziane (2001), who reported an increase in creatinemia in the pregnant female, which could be due to a protein deficiency (Valtonen *et al.*, 1982), or to the intense activity of thyroid during gestation. Though, El-Sherif and Assad (2001); Roubies *et al.* (2006) cited significant influence of the reproductive stage on serum creatinine, and it was higher in pregnant versus lactating ewes, which was attributed to the development of fetal muscles; a result confirms our observations. Such an increase in creatinemia was also reported during the late-gestation of cow, and was related to the same reasons (Tainturier *et al* (1984). However, Yokus *et al* (2006) found the opposite, the highest creatinemia was found in lactating ewes, but this rise was not significant. Hamadeh *et al.*, (2006) noted no considerable effect of lactation on serum creatinine. In contrast, Caldeira *et al.* (2007) showed an increase in creatinemia of ewes subjected to poor nutrition.

Comparison between the two seasons

The comparison of each physiological stage between winter and spring was shown in Fig.s 6-10. The statistical analysis shows no significant effect of the season on blood glucose. Low serum glucose levels in animals in spring compared to winter were observed, especially in pregnant versus lactating ewes.

This result agrees with those described by Yokus *et al.* (2006), who confirmed that changes in blood glucose do not have a seasonal rhythm and with those of Antunovic *et al.* (2002), who reported low summer blood glucose levels in pregnant ewes and noted that lactating ewes had higher values during the same season. Contrary to our results, they emphasized that these values are diminished during the winter. This finding may be due to poor dietary intake (Bennis *et al.*, 1994). This could be explained by the imbalance of the ration by insufficient intake of easily and highly fermentable carbohydrates, and therefore a negative energy balance of the ration (Chorfi and Girard, 2005). For Bocquier *et al.* (1998) Ruminant blood glucose is a parameter that is not very sensitive to differences in dietary intake, but according to Kleeman *et al.* (2005), blood glucose was strongly affected by diet.

Cholesterolemia in spring is relatively higher than winter values in all groups of animals. In addition, pregnant ewes had higher cholesterol levels than lactating ewes in spring and vice versa in winter. The statistical study showed a significant difference between the two seasons. Our observations are consistent with Baumgartner and Pernthaner (1994) who noted significant differences in serum cholesterol concentrations between the two seasons (spring and winter), while Yokus *et al.* (2006) did not describe any significant influence of the season on serum cholesterol levels. Those of Ramos *et al.* (1994), who reported elevated serum cholesterol levels in spring in pregnant ewes compared to suckling ewes. This might be explained by the mobilization of hepatic lipoproteins during late pregnancy. Apparently, the season (spring, winter) significantly influenced the cholesterolemia of Ouled Djellal ewes.

No significant effect of the season on triglycerides' levels was obtained in our study. The same result was reported by Baumgartner and Pernthaner (1994). In addition, this situation has also been observed in goats (Krokavec *et al.*, 1992). However, Yokus *et al.* (2006), reported a significant seasonal influence on serum triglyceride levels in ewes, and recorded a significant increase in this parameter during the dry season.

The increase in triglyceridemia in spring may be due to the decrease in insulin level in ewes following an elevation in ambient temperature (Yokus and Cakir, 2006a).

Table 6. Variations of plasma glucose (g/l) of Ouled djellal during winter and spring.

Glucose		Mean ± SD	*p*
Season	Gestationals in winter	0.677± 0.040	NS
	Gestationals in spring	0.62 ± 0.410	NS
	Lactatings in winter	0.595 ± 0.76	
	Lactatings in spring	0.577 ± 0.115	

Table 7. Variations of plasma cholesterol (g/l) of Ouled djellal during winter and spring.

Cholesterol		Mean ± SD	*p*
Season	Gestationals in winter	0.48 ± 0.092	S
	Gestationals in spring	0.643 ± 0.124	NS
	Lactatings in winter	0.472± 0.111	
	Lactatings in spring	0.549 ±0.095	

S: significant at p<0,05.

Table 8. Variations of plasma triglycerides (g/l) of Ouled djellal during winter and spring.

Triglycerides		Mean ± SD	*p*
Season	Gestationals in winter	0.364 ± 0.069	NS
	Gestationals in spring	0.393 ± 0.025	NS
	Lactatings in winter	0.319 ± 0.055	
	Lactatings in spring	0.341 ±0.089	

Table 9. Variations of plasma urea (mg/l) of Ouled djellal during winter and spring.

Urea		Mean ± SD	*p*
Season	Gestationals in winter	0.224 ± 0.040	NS
	Gestationals in spring	0.257 ± 0.067	S
	Lactatings in winter	0.245 ± 0.071	
	Lactatings in spring	0.368 ±0.145	

S: significant at p<0,05.

Table 10. Variations of plasma creatinine (mg/l) of Ouled djellal during winter and spring.

Creatinine		Mean ± SD	*p*
Season	Gestationals in winter	9.697± 0.752	S
	Gestationals in spring	11.046 ± 0.791	NS
	Lactatings in winter	9.562 ± 0.982	
	Lactatings in spring	9.723 ± 1.022	

S: significant at p<0,05.

The statistical study revealed a significant influence of the season on the uremia, where higher values were in spring than in winter. This result is in agreement with Kwiatkowski *et al.* (1985) who reported elevated serum urea levels in ewes at the end of gestation and lactation during spring compared to winter. Antunovic *et al.* (2002) also cited the same result, while Yokus *et al.* (2006) reported very low values of this parameter during the spring.

The results showed a significant influence of the season on serum creatinine, with higher values observed in spring compared to winter. Additionally, Baumgartner and Pernthaner (1994) reported a similar observation, citing creatinine as one of the blood parameters whose rate is significantly influenced by the season. It has been confirmed that serum creatinine levels remain stable in animals under different diets (Caldeira *et al.*, 2007). In addition, this parameter increases in case of water deficiency (Hamadeh *et al.*, 2006) and during the dry season (Yokus *et al.*, 2006).

Conclusion

This study has focused on the variation of biochemical markers of the most famous breed in the country grazing in a semi-arid zone. The most interesting results showed that only urea and creatinine levels were different between gestational and lactating ewes during spring, with no variation in the cold season. When comparing the two seasons, spring is characterized with higher concentrations of cholesterol and creatinine at gestation, and urea at lactation. Such variations are certainly related to the ecophysiological factors of both the breed and the semi-arid area.

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