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Characterization of goat neonatal mortality in northern Morocco and impact of colostrum supplementation

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Abstract. This present work aims (1) to characterize neonatal mortality of young goats in northern Morocco in relation with passive transfer of immunity via colostrum, and (2) to test a complementation strategy with commercial colostrum in order to increase kid's immunoglobulin concentration levels for a better protection against infections. This study was performed between November 2016 and May 2018 in northern Morocco. (1) A group of 1236 newborn kids of Beni Arouss, Northern breed and Northern cross breeds where monitored every 15 to 20 days. Regular weight assessment and blood samples on kids aged between 0 and 14 days were performed. (2) For complementation assay (2017-2018), 65 Beni Arouss goat kids were chosen to receive commercial colostrum. To maintain the mother-young bond, kids were allowed to suckle their mother's immediately after birth. Then, they received one meal (50 between 150 ml of bottled commercial colostrum) for 3 consecutive days, in addition to maternal milk. Animals of this group were compared to non supplemented Beni Arouss kids living in the same farming conditions (n=81). Results showed a mortality rate in goat kids of northern Morocco of 16%, which was significantly lower in Beni Arouss (8%; p<0.01) and mountainous pastures (11%; p<0.05). Median immunoglobulin levels were significantly lower in Beni Arouss kids (8.20 g/L; p<0.05). Supplementation with commercial colostrum of Beni Arouss goat kids in addition to their mother's milk did not reduce mortality rate. Mortality occurring between 0-3 days was however decreased (10% versus 31% in non-complemented kids) and immunoglobulin levels were significantly increased (18.95 g/L versus 8.32 g/L in non-complemented kids; p<0.05).

Keywords. Neonatal mortality – Goat – Northern Morocco – Immunoglobulin.

Caractérisation de la mortalité néonatale caprine dans le nord du Maroc et impact de la supplémentation en colostrum

Résumé. *Le présent travail vise (1) à caractériser la mortalité néonatale des chevreaux dans le nord du Maroc en relation avec le transfert passif de l'immunité via le colostrum, et (2) à tester une stratégie de complémentation avec du colostrum commercial afin d'augmenter les niveaux de concentration en immunoglobuline des chevreaux pour une meilleure protection contre les infections. Cette étude a été réalisée entre novembre 2016 et mai 2018 dans le nord du Maroc. (1) Un groupe de 1236 nouveau-nés de Beni Arouss, races du Nord et races du Nord croisées ont été suivis tous les 15 à 20 jours. Une évaluation du poids et des prélèvements de sang sur les chevreaux âgés de 0 à 14 jours ont été effectués régulièrement. (2) Pour l'analyse de la complémentation (2017-2018), 65 chevreaux Beni Arouss ont été choisies pour recevoir du colostrum commercial. Pour maintenir le lien mère-jeune, les chevreaux étaient autorisés à téter immédiatement après la naissance. Ensuite, ils ont reçu un repas (50 entre 150 ml de colostrum commercial en bouteille) pendant 3 jours consécutifs, en plus du lait maternel. Les animaux de ce groupe ont été comparés à des chevreaux Beni Arouss non complémentés vivant dans les mêmes conditions d'élevage (n = 81). Les résultats ont montré un taux de mortalité de 16% chez les chevreaux du nord du Maroc. La mortalité néonatal était nettement inférieur à Beni Arouss (8%; p <0,01) et dans les pâturages montagneux (11%; p <0,05). Les taux médians d'immunoglobuline étaient significativement plus faibles chez les chevreaux de la race Beni arouss (8,20 g / L; p <0,05). La supplémentation en colostrum commercial des chevreaux Beni Arouss en plus du lait de leur mère n'a pas réduit le taux de mortalité. La mortalité survenant entre 0 et 3 jours a cependant diminué (10% contre 31% chez les chevreaux non complémentés) et les taux d'immunoglobuline ont été significativement augmentés (18,95 g / L contre 8,32 g / L chez les chevreaux non complémentés; p < 0,05).*

Mots clés. *Mortalité néonatale – Chèvre – Nord du Maroc – Immunoglobuline.*

I – Introduction

High levels of mortality in young goats are recognized as a major constraint on goat production wherever goats are raised. In extensive management systems, kid losses have been reported in the range from 10 to 60% (Grafton, 1993). In northern Morocco, high mortality rates of young goats range from 16% to 34% (Chentouf *et al*., 2014).These deaths occur most frequently in the first few days of life. Numerous factors contribute to this early mortality, including low birth weight, short gestation period, large litter size, poor mothering, and hypothermia, as well as other environmental and weather conditions at the time of kidding. In addition, the failure to suckle adequate colostrum at birth contributes significantly to the preponderance of early kid deaths, most likely through the mechanism of failure of passive transfer of humoral immunity (Grafton, 1993).

This present work aims to characterize mortality of young goats in northern Morocco in relation with passive transfer of immunity via colostrum, and test a complementation strategy with commercial colostrum in order to increase kid's immunoglobulin concentration levels for a better protection against infections.

II – Materials and methods

1. Study design

In order to compare a range of appropriate situations throughout two seasons of follow-up: 2016-2017 (n=16) and 2017-2018 (n=9) in northern Morocco, we selected farms in rural areas that had smallholder farmers, clear access to farms during wet season.

2. Animals' enrolment

Only females that gave birth during the study period were eligible (n=1106). Kidding season begun in December and ended in March of each year. All along this season, farms' visits were scheduled every 15 to 20 days. During visits, first time checked newborns (n=1236) were given numbered neck tags that switched to numbered ear tags 30 days later and were weighed. Blood sampling was performed if kid's age ranged between 0 and 14 days at first investigation (n= 80).

For the supplementation assay that was conducted in 2017-2018, a total of 65 Beni Arouss goat kids were chosen to receive commercial colostrum Globigen® (Alliance pastorale, France).

To maintain the mother-young bond, kids were allowed to suckle their mother's immediately after birth. Then, they received one meal (50 between 150 ml of bottled commercial colostrums) for 3 consecutive days, in addition to maternal milk. Animals of this group were compared to 81 non supplemented Beni Arouss kids living in the same farming conditions (n=81).

3. Sampling and determination of IgG concentrations

To estimate the efficiency of passive immunity transfer from goats to their newborns, a single jugular blood sample was taken from newborn kids aged less than 14 days. Supplemented group kids were sampled twice (at 48h and 7 days after birth). Blood samples were centrifuged and serum stored at –4°C. Blood serum was assayed to determine IgG concentration by radial immunodiffusion technique using RID Sheep and Goat IgG test (IDBiotech,France). Detection limit was 5 ! g/ml. The inter-assay coefficient of variation (CV) was 7%; intra-assay CV was 5%.

4. Statistical analysis

Data of IgG concentrations were analyzed as a linear mixed model after log10 transformation. The model was fitted in the R statistical environment using the lme4 package. In addition, boxplots of non transformed data were plotted to check for any factors' effect. Mortality data were analyzed as a generalized linear model (GLM).

III – Results and discussion

In northern Morocco, the most common breeds are: the Northern Cross population which is the result of a cross between local breed and an imported breed; the Northern Local population; and Beni Arouss goat recently recognized as a breed by the Ministry of Agriculture (Chentouf *et al*., 2014). Farmers use either forest resources from lowlands or mountains for goats' pasture.

The overall goat mortality rate in our study was 16%. Our results were similar to those in extensive goat farms of northern Morocco when goat kids mortality rate was estimated at 16.2% between 2003 and 2004 (Chentouf, *et al*., 2006). Mortality rate in kids born in lowlands (23%) was higher compared to that of kids born in the mountains (11%) ($p<0.05$). The difference in death rates was also significant ($p=0.01$) between the three breeds of the region: the Northern Cross population (8%), the Northern Local population (17%) and Beni Arouss goat (8%).

Immunoglobulin concentration level was highly affected by breeds ($p<0.05$). The median concentrations of each breed were: 10.22 g/l for the Northern Cross population, 10.76 g/l for the Northern local population (17%) and 8.20 g/l for Beni Arouss goat (Fig. 1). Our results were similar to the study confirming that kids with immunoglobulin levels <8 g/l showed lower survival rates than those with higher concentrations (Mellado *et al*., 1998).

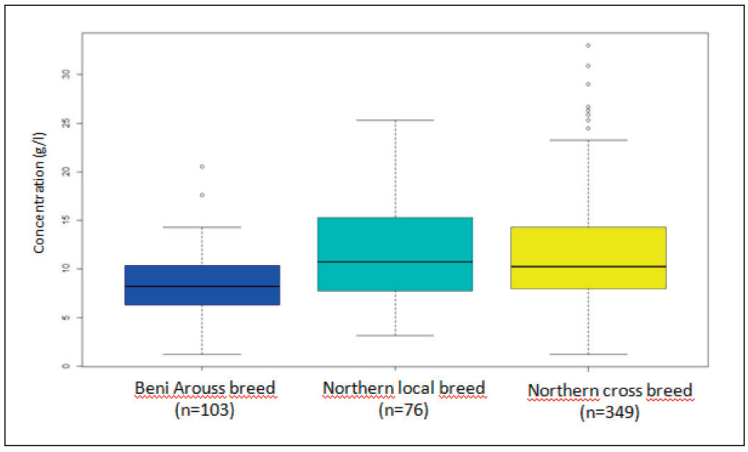

Fig. 1. Effect of breed on serum IgG concentration (g/L) in goat kids after colostrum intake.

Regarding colostrum supplementation, mortality rate equalled 15% in supplemented group and 16% in non supplemented goats (Table 1). Mellado and colleagues (1998) found similar results under extensive management conditions in the arid zones of Mexico during spring: this study showed that reduced immunoglobulin concentration in kids was not associated with lower survival rates.

Results showed a highly significant effect of supplementation using commercial colostrum on immunoglobulin levels compared to non supplemented group ($p<0.05$). Values for dead kids were at 20.66 g/L at 48 h and 10.39 g/L at 7 days in supplemented group and 8.20 g/L at 48 h and 7.62 g/L at 7 days in non supplemented group, respectively. For alive kids the levels were 18.95 g/L at 48h and 13.04 at 7 days versus 8.32 g/L at 48h and 8.20 at 7 days (Table 1).

There was no significant differences between dead and alive kids' immunoglobulin levels in both groups. Supplemented dead kids showed 20.66 g/L at 48h and 10.39 g/L at 7 versus 18.95 g/L at 48h and 13.04 g/L at 7 days for supplemented alive kids. Values in non supplemented kids group were at: 8.20 g/L at 48h and 7.62 g/L at 7 days for dead kids versus 8.32 g/L at 48h and 8.20 g/L at 7 days for alive kids (Table 1). Mortality occurring between 0-3 days was however decreased in complemented kids 10% versus 31% in non-complemented kids.

Table 1. Median IgG concentrations (g/L) and death rates in supplemented and not supplemented goat kids

	Supplemented kids				Not supplemented kids			
	Dead occurring during follow up		Alive throughout follow up		Dead occurring during follow up		Alive throughout follow up	
Time	48h	7 days	48h	7 days	48h	7 days	48h	7 days
Number	10	8	55	55	7	6	42	25
Median (g/L)	20.66a	10.39a	18.95a	13.04a	8.20b	7.62b	8.32b	8.20b
Max.	28.29	20.66	33.01	25.10	12.05	13.06	17.63	14.30
Min.	13.39	6.73	8.68	5.89	4.29	2.09	1.74	1.74
Mortality rate			15%				16%	

Data shown in the row with different letters (a and b) has a significant difference ($p<0.05$).

IV – Conclusion

In our study, mortality rate in goat kids of northern Morocco was of 16% between 2016 and 2018 and was highly affected by goats' breed and type of pasture, with Beni Arouss population and mountainous pastures showing the lowest mortality rate. Immunoglobulin levels after colostrum absorption were lowest in Beni Arouss goat kids. Supplementation with commercial colostrum of Beni Arouss goat kids in addition to their mothers' milk increased significantly post-colostrum serum immunoglobulin levels but did not reduce mortality.

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