Effect of Water Restriction on Thermoregulation and Some Biochemical Constituents in Lactating Aardi Goats During Got Weather Conditions

Mohammed Alamer

Department of Animal and Fish Production, College of Agricultural Sciences and Foods, King Faisal University, Hofuf, Saudi Arabia

Abstract :

This study was conducted to assess the effect of water restriction on some physiological variables in lactating Aardi goats. The trial was divided into 3 periods each of 6 days; control, water restriction and rehydration. Aardi goats in early lactation were divided into two groups. One group (n=5) received 50% and the other group (n=4) received 25% restriction of drinking water relative to their water consumption during the control period. Respiration rate and sweating rate were not affected by water restriction and therefore, rectal temperature was maintained without changes. Compared to 25% restriction, 50% water restriction resulted in a steady increase in plasma sodium and osmolality, which was an indication of hemoconcentration as a consequence of water depletion from the plasma compartment. Water restriction did not induce any obvious changes in plasma glucose and urea, and packed cell volume. However, plasma creatinine increased progressively with 50% restriction, which may be indicative of lower glomerular filtration rate. This study indicates that lactating Aardi goats can tolerate a sustained 50% water restriction with minimal physiological alterations even when it was coupled with a high ambient temperature.

Keywords: Water restriction, Goats, Physiological responses, Desert environment

Introduction

Drinking water is an absolute requirement for livestock and an absence of a sufficient supply of water can be a critically limiting factor in animal physiology and productivity. In desert and arid areas, the climatic conditions that prevail for most of the lengthy summer months are very hot with limited supply of water. These harsh conditions constitute potential constraints for animals inhabiting such areas as their productivity is likely to be impaired.

Due to limited water in such regions, animals drinking frequency may not satisfy their water requirements. Therefore they have acquired various adaptation mechanisms that aid them to withstand water deficit (Kay 1997). They are capable of evolving high water economy and utilizing their body water more efficiently. Therefore, performance is maintained with minimal disturbance during periods of water scarcity (Silanikove 1994).

Breeds of ruminants that are successfully adapted to desert conditions exhibit potential to ameliorate the stressful effects of water inefficiency (Silanikove 2000) and use different strategies to cope with water stress. As a consequence, their performance is maintained with minimal alteration compared with non-desert breeds. Desert adapted ruminants have evolved a variety of mechanisms that reduce water loss from their bodies and withstanding dehydration.

Goats are considered suitable animals for raising in such regions, since they were the first domesticated animals in the hot and arid zones of the world. They use body water more efficiently and are considered less sensitive to water scarcity than other ruminants (Giger-Roverdin & Gihad 1991). Goats have relatively large rumen compared to other ruminants (Bhattacharya 1980) which enhance their capacity of storing water to buffer any inadequate water supply during drought. Various reports have detailed goats capability of enduring dehydration (Shkolnik & Choshniak 1985; Silanikove 1994, 2000). During terms of water deficit, goats activate several water saving mechanisms that would result in reducing their water losses and hence enhancing their capacity to tolerate water deficit (Maltz *et al.* 1984; Silanikove 2000). Reduction of moisture content of feces and urine and elevation of urine osmolality are mechanisms by which ruminants reduce water loss during dehydration. Another venue of excessive water loss during hot weather is through evaporative cooling; panting is reduced in water deprived sheep (Singh *et al.* 1982), and this contribute to water conservation.

However, the capacity of resisting water scarcity and coping processes behind it may vary among breeds and will determine their desert worthiness. The physiological mechanisms that allow desert adapted goats to survive with inadequate supply of water is consistent with the great capacity to tolerate critical body water losses in conjunction with minimizing water losses (Silanikove 2000) Two phenomenon that generally arise in the course of dehydration, hyper-osmolality of the blood and hypovolemia which have a great impact on the thermoregulatory water loss. Elevated body fluid solutes concentration motivates an adjustment in thermoregulatory processes throughout times of water deficits. A meaningful association between the suppression of sweating rate and the rise in serum osmolality during dehydration has been proposed (Senay 1979). It has been revealed in goats that elevation in plasma osmolality ended in a diminution in thermoregulatory evaporation concurrently with hyperthermia (Baker & Doris, 1982).

Lactation and elevated environmental temperature are chief elements that drain body water and hence increase the demand for water by animals. Maintaining milk secretion during dehydration is of a great significance in ruminants living in desert and arid areas of the world. Therefore, lactating animals should acquire greater ability of water saving mechanisms compared to non-lactating ones. Since maintaining plasma volume is of great significance in milk secretion and therefore, lactating goats have greater ability of conserving plasma volume during dehydration than non-lactating goats (Olsson *et al.* 1983; Maltz & Shkolnik 1984). In addition, lactating goats found to possess greater ability to concentrate urine compared to non-lactating individuals during dehydration (Maltz & Shkolnik 1984) which could be attributed to higher plasma vasopressin levels (Mengistu *et al.* 2007). Lactating goats have an ability to reduce evaporative cooling and allow body temperature to rise above that in non-lactating goats during dehydration (Olsson & Dahlborn 1989; Olsson 2005) which could be viewed as an important strategy employed by lactating animals to economize on water. Collectively, this evidence indicates that the water conservation mechanisms operate to a greater extent during lactation to ensure adequate water supply for milk secretion.

The Aardi breed is an indigenous goat's breed of Saudi Arabia which is well known for adaptation to desert conditions particularly high environmental temperature and water shortage (El-Nouty *et al.* 1990; Alamer 2003). Alamer (2009) has reported that lactating Aardi goats can withstand 50% reduction in water intake under heat stress conditions with a minimal disturbance in their performance. However, the mechanisms allowing this desert breed to cope with water restriction under severe heat stress needs to be elucidated. This study was therefore designed to assess various physiological responses to water restriction of lactating Aardi goats under heat stress conditions during summer season in Saudi Arabia. Their ability to rehydrate was also estimated by determining their ability to restore their body functions following hydration at the termination of water restriction.

Materials and methods

The experiment was carried out at the Agricultural and Veterinary Research and Training Station of King Faisal University in Alhassa, Saudi Arabia. The climate in Saudi Arabia is generally classified as desert with a dry climate, very hot and dry summer season. However, Alhassa region is one of the hottest and driest areas of Saudi Arabia, where ambient temperatures may reach 50 ˚C during the summer. The annual rainfall is about 74 mm, spread over an average of 31 days during the winter season, without any precipitations during the lengthy hot summer months.

Experimental animals

Nine 2-4 years old lactating goats of Aardi breed weighing 38.5±1.8 kg were used in this study. They were on their 2nd to 4th lactation and in 28-42 days postpartum at the start of the study. The does were individually housed (1.5m×2.0 m) and fed 0.5 kg of a commercially formulated concentrate (11% CP), with alfalfa hay and water ad libitum. The concentrate mixture was made up of corn, barley, wheat bran, molasses, minerals and vitamins.

Experimental procedure

The experiment was divided into 3 periods each of 6 days: control (hydration), water restriction, and rehydration. During the control period, all does were allowed free water *ad libitum*. Goats were divided into two groups that matched for milking yield, and were subjected to 50% (n=5) or 25% (n=4) water restriction. The restriction of water was related to individual *ad libitum* free water intake during the control period (hydration). During the restriction period, lactating goats had access to water buckets from 0600 h until the allotted quantity of water was consumed. Hay and concentrate, however, were offered twice a day as usual at 08:00 h and 16:00 h. During rehydration period, goats were allowed free water *ad libitum*.

Measurements

Respiration rate (RR), rectal temperature (RT) and sweating rate (SR) were determined throughout the experimental days every 2 days at 12:00h. Sweating rate was measured on the neck area utilizing the cobalt chloride disc method (Schleger & Turner, 1965).

Blood samples were collected, from the jugular vein at 07:00h daily, into heparinized vacutainers. Packed cell volume (PCV) was determined immediately following blood collection by centerfusion of blood samples aspirated into heparinized capillary tubes which were then read by a circular micro-capillary tube reader (model 2201, MA, USA). Then, blood samples were centrifuged for 15 minutes and plasma was obtained and stored at –20 ºC till analysis. Plasma osmolality (OSM) was determined by freezing point depression utilizing osmometer (Osmometer 800CL, Slamed, Germany). Commercial kits were used for determinations of plasma glucose (Glucose Oxidase method, Nubenco Diagnostics, New Jersey, USA), plasma urea (no. 021, United Diagnostics Industry, Dammam, Saudi Arabia), and plasma creatinine (Biosystems, Barcelona, Spain). Plasma sodium (Na) concentration was determined by a clinical flame photometer (Jenway, Essex, England).

The minimum, maximum and average ambient temperature and relative humidity during experimental period are summarized in Table 1.

Table 1

Maximum, minimum and average daily ambient temperature and relative humidity during experimental period

	Ambient temperature (˚C)			Relative humidity (%)		
Period	Maximum	Minimum	Average	Maxi mum	Mini mum	Ave rage
Control	44.9	27.5	35.6	36.8	9.8	20.8
Restriction	46.8	28.6	37.5	27.8	9.8	17.2
Rehydration	44.6	28.1	36.1	31.0	12.7	20.5

Statistical analysis

Within animal variation over days and variation between groups was analyzed using the repeated measurement analysis of variance utilizing the MIXED PROC of SAS software (SAS 1996). The model included group, day and group x day. Day was included as a repeated measurement. When the day effect was significant, pair-wise comparisons were made using Least Square Means. All values are presented as means ± SE.

Results

During water restriction, RR was maintained without any changes in both groups other than a significant ($P<0.01$) rise during the last day of restriction in the 50% restricted group (Figure 1a). Restoration of water resulted in a steady decline in respiratory frequency with the progress of rehydration in goats with 50% water restriction. Rectal temperature tended to be higher in the 5o % group during the pre-restriction period (Figure 1b). However, RT did not change in response to water restriction and therefore there were no significant differences either within groups or between groups.

Also, analysis of data did not reveal any effect of water restriction on SR (Figure 1c). However, cutaneous water loss tended to fall with 50% water restriction with the advance of water restriction. Full water restoration did not induce any changes in SR in both treatment groups.

Plasma Na exhibited a progressive rise with the advance of water restriction in goats receiving 50% restriction, while it was maintained without any significant changes in the other group (Figure 2a). During the second day of rehydration, plasma Na significantly decreased ($P<0.05$) in both groups. Water restriction did not cause any significant changes in PCV, but a tendency of increase was observed during the last day of water restriction with 50% restriction (Figure 2b). Rehydration led to a significant decline ($P <0.05$) in PCV during the second day of rehydration in both groups.

Plasma OSM began to rise significantly ($P<0.01$) with 50% restriction during the first 4 days of restriction and continued to increase towards the last day of restriction period (Figure 2c). On the other hand, 25% water restriction did not affect plasma OSM. Evidently, rehydration induced a sharp drop in plasma OSM ($P<0.01$), which remained below the pre-restriction values for the first 2 days of water restoration in both groups. However, plasma OSM almost returned to control levels by day 4 of rehydration, regardless of water treatment.

No differences were observed between the hydration and water restriction periods in plasma levels of glucose (GLU) and urea (URE) in both groups (Figures 3a, b). However, both groups showed a tendency of decline ($P>0.05$) in plasma GLU. During the 6 days of water restriction, plasma CRE increased ($P<0.05$) in goats exposed to 50% water restriction, but not in goats with 25 % restriction (interaction group x day; P= 0.056, Figure 3c). Plasma level of creatinine (CRE) increased steadily from the second day of restriction until the end of dehydration period in the 50% group. Also, during the entire of water restriction period, an obvious variation between the two groups in CRE was noted, which reached significance ($P<0.01$) during the last day of restriction. By the end of the second day of rehydration, plasma CRE of the 50% restricted group had returned to values seen during the hydration period.

Discussion

Goats in the present study were under high heat loads as judged by the high ambient temperature that prevailed during the time of water restriction and a relatively high milk production level (average of 1.8 l/day). Under such conditions, water insufficiency may impose a significant burden on body water equilibrium and the thermoregulatory processes may be adjusted in an effort to save body water. However, in the present study Aardi goats were able to maintain undisturbed thermal balance during water restriction and thus evaporative cooling was effective in preventing hyperthermia. In this study, RT was recorded at 1200 h which may imply that the goats might have not been exposed to a relatively high thermal load to induce a significant change in RT. However, the ambient temperature recorded at the time of RT measurement did not go below 40 ˚C, indicating that the goats were actually exposed to a comparatively high heat burden.

Pulmonary evaporation is a major avenue of water loss, and dehydrated animals often have lower respiratory rates that initiate panting at higher ambient temperature than do normally hydrated ones. The results obtained in this study are at variance with reports that indicated a reduction in RR during periods of insufficient water intake in lactating cows (Little et al. 1978), sheep (Ismail *et al.* 1996) and goats (Olsson & Dahlborn 1989) and as a consequence, body temperature was shown to rise. It was noted that the animals in those studies were exposed to a moderate rather than high heat loads during water stress.

The extent of dehydration and thermal load which are related to the heat load that determines the thermoregulatory modulation. Alamer and Al-

Hozab (2004) have shown that dehydrated Awassi rams reduced their RR during moderate heat exposure, while it was maintained unchanged when they were exposed to a higher heat load.

State of hydration is one of the factors that affect cutaneous water loss. A marked suppression of SR has been noted following water deprivation under heat exposure in goats (Baker 1989; Das *et al.* 1994). Furthermore, the dehydrated Black Bedouin goats has been reported to reduce their sweating rate by 32% whilst a marked increase in pulmonary evaporation was evident when water deprivation was executed under elevated environmental temperature (Robertshaw & Dmi'el 1983; Dmi'el 1986). This shows that heat defense mechanisms are adjusted in accord with water equilibrium of the animal. In the present study, cutaneous evaporation tended to decline with 50% restriction which is in agreement with reports that indicated a fall in SR in dehydrated lactating goats (Olsson & Dahlborn 1989). In addition, lactation may interfere with this response since it has been shown that the reduction in SR occurred at an earlier stage in lactating animal compared to non-lactating ones during dehydration (Olsson & Dahlborn 1989). Thus, the sensitivity of sweating response to the body additional heat may have been reduced by water deficiency in the 50% restricted goats.

The observed hypernatremia by 50% reduction in water consumption was consistent with reports in sheep and goats that indicated an increment in electrolyte concentration during water deficit (Burgos *et al.* 2001; Mengistu et al. 2007; Casamassima *et al.* 2008; Ghanem et al. 2008). It has been indicated that hypernatremia could be referred to a decrease in plasma volume owed to body fluid deficit that leads to haemoconcentration. However, lack of significant alterations in PCV did not support this explanation. The additional mechanism that is implicated in the regulation of blood level of Na is the rennin-angiotensin-aldosterone system. Aldosterone hormone secreted by the adrenal cortex is sensitive to low water content of the extracellular fluid (Carlson 1997). Depression of plasma volume during water lack is known to stimulate the liberation of this hormone which lowers the Na elimination by acting in the renal tubules to preserve plasma sodium.

Plasma OSM increased rapidly with 50% restriction and displayed a further increase during the final day of the restricted period. This was in accord with various reports that evidently indicated a rise in plasma OSM during periods of water deficits in lactating goats (Hossaini-Hilali *et al.* 1994; Mengistu *et al.* 2007). This hyperosmolality might be an indication of water depletion in the extracellular fluid as a consequence of steady water restriction. The state of hypovolemia which cannot be averted when the animals confronted a water deficit could be pronounced during periods of higher water expenditure such as during lactation and thermal stress.

The Na content of the plasma can be accounted to nearly 60% of the osmo-concentration activity and therefore, the rise in Na usually parallels a rise in plasma osmolality (Mengistu *et al.* 2007). It appears that maintaining hyperosmolality of the blood is needed for water shifts to the vascular system to balance for the continuously losses of plasma water.

The rumen which serves as a water reservoir resembles a significant key factor of the high resistance to water stress in ruminants compared to mono-gastric animals. Rumen fluid is utilized during dehydration period and can contribute 68% of total body fluid loss in goats (Brosh *et al.* 1986). The rumen role in this content is noted to be more pronounced in desert adapted species (Silanikove 1994, 2000).

In the present study, water balance could have been maintained by fluid drawn from the rumen during the first few days of water restriction as has been indicated in sheep (Dahlborn & Holtenius, 1990). This could buffer any changes in plasma volume during the initial stages of dehydration.

Hyperhydration might have come about during the first 48 hours of rehydration as indicated by the hypo-osmolality of the plasma in comparison to pre-restriction levels in both groups. This expansion of plasma volume could imply that Aardi goats were able to retain surplus water for a comparatively long time possibly to defeat any expected period of limited water supply.

In lactating Moroccan goats, a hypo-osmolality of plasma was sustained for 30 hours following rehydration that terminated a water deprivation session (Hossaini-Hilali *et al.* 1994). Also, it has been reported in camels that water can be retained in the forestomach for several hours following rehydration (Benlamilh *et al.* 1992).

Taken together, these results suggest that desert adapted ruminants have the capability to reserve surplus water for a substantial time following rehydration which could be regarded as a potential adaptation mechanism to compact infrequent watering.

The observed hypoglycemia could be attributed to the depression in feed consumption seen in these goats during water restriction (Alamer 2009). The observed decline in plasma glucose levels during water restriction was in accord with reports in which water was partially or completely restricted in sheep (Abdelatif & Ahmed, 1994; Ismail *et al.* 1996). This response might be linked to the fall in the level of feeding. Nonetheless, feed intake depression during water restriction may not always provoke hypoglycemia (Ghanem *et al.* 2008).

The increase in plasma CRE levels with 50% restriction has also been reported in water deprived sheep (Ismail et al. 1996; Abd El-latif *et al.* 1997). Also, lactating Comisana ewes exhibited a significant rise in CRE following 60% water restriction (Casamassima et al. 2008). Previously, Alamer (2006) has shown a progressive increase in plasma CRE with the progress of water deprivation in Aardi bucks. This rise in CRE may be due to a decline in CRE clearance (Puri & Kataria, 2004) induced by a fall in glomerular filtration rate (Ghosh *et al.* 1976).

Conclusion

Goats of the present study maintained normal thermoregulatory operations during steady water restriction and therefore, core body temperature was kept at normal rates. The rise in plasma CRE might be suggestive of a lower glomerular filtration rate. Also, results might indicate possible water retention in the extracellular compartment for a considerable length of time following rehydration which might be considered as an adaptation to variation in water supply. However, further studies are needed to evaluate the effect of water restriction for longer periods on the physiological status and productivity of these native goats.

References

1. Abdelatif, A.M., Ahmed, M.M.M. (1994): Water restriction, thermoregulation, blood constituents and endocrine responses in Sudanese desert sheep. J. Arid Environ., 26: 171-180.
2. Abd El-latif, H., Ismail, E., Salem, M., Hassan, GA. (1997): Effect of dehydration on some biochemical constituents of blood in Barki, Suffolk and their crossbred sheep. Indian J. Anim. Sci., 67: 786-791.
3. Alamer, M. (2009): Effect of water restriction on lactation performance of Aardi goats under heat stress conditions. Small Rumin. Res., 84: 76-81.
4. Alamer, M. (2003): Heat tolerance of local goat breeds in Saudi Arabia. Arab Gulf J. Sci. Res., 21: 210-216.
5. Alamer, M., Al-Hozab, A. (2004): Effect of water deprivation and season on feed intake, body weight and thermoregulation in Awassi and Najdi sheep breeds in Saudi Arabia. J. Arid Environ., 59: 71-84.
6. Alamer, M. (2006): Physiological responses of Saudi Arabia indigenous goats to water deprivation. Small Rumin. Res**.,** 63: 100-109
7. Baker, M.A. (1989): Effects of dehydration and rehydration on thermoregulatory sweating in goats. J. Physiol., 417: 421-435.
8. Baker, M.A., and Doris, P.A. (1982): Effect of dehydration on hypothalamic control of evaporation in the cat. J. Physiol**.,** 322: 457-468.
9. Benlamlih, S., Dahlborn, K., Filali, R.Z., Hossaini-Hilali, J. (1992): Fluid retention after oral loading with water or saline in camels. Am. J. Physiol., Regul., Integr. and Compar. Physiol., 262: R915-R920.
10. Bhattacharya, A.N. (1980): Research on goat nutrition and management in Mediterranean, Meddle East and adjacent Arab countries. J. Dairy Sci., 63: 1681-1700.
11. Brosh, A., Choshniak, I., Tadmor, A., Shkolnik, A. (1986): Infrequent drinking, digestive efficiency and particle size of digesta in black Bedouin goats. J. Agric. Sci., Cambr., 106: 575-579.
12. Burgos, M.S., Senn, M., Sutter, F., Kreuzere, M., Langhans, W. (2001): Effect of water restriction on feeding and metabolism in dairy cows. Am. J. Physiol.-Regul. Integr. and Compar. Physiol., 280: R418-R427.
13. Carlson, G.P. (1997): Fluid, electrolyte and acid-base balance. In: Kaneko, M.L., Harvey, H.W., Bruss, M. L. (eds), *Clinical Biochemistry of Domestic Animals*, pp 485-516. Academic press (Fifth edition), San Diego, California,.
14. Casamassima, D., Pizzo, R., Palazzo, M., Alessandro, A.G.D., Martemucci, G. (2008): Effect of water restriction on productive performance and blood parameters in Comisana sheep reared under intensive condition. Small Rumin. Res., 78: 169-175.

15. Dahlborn, K., Holtenius, K. (1990): Fluid absorption from the rumen during rehydration in sheep. Experi. Physiol., 75: 45-55.

16. Das, S.K., Kumar, P., Singh, D., Singh, K. (1994): Effect of water restriction on thermoregulatory responses in bucks. Indian J. Anim. Sci., 64: 899-901.

17. Dmi'el, R. (1986): Selective sweat secretion and panting modulation in dehydrated goats. J. Therm. Biol., 11: 157-159.

18. El-Nouty, F.D., Al-Haideray, A.A., Basmaeil, S.M. (1990): Physiological responses, feed intake, urine volume and serum osmolality of Aardi goats deprived of water during spring and summer. Aust. J. Anim. Sci., 3: 331–336.

19. Ghanem, A.M., Jaber, L.S., Abi Said, M., Barbour, E.K., Hamadeh, S.K. (2008): Physiological and chemical responses in water-deprived Awassi ewes treated with vitamin C. J.Arid Environ., 72: 141-149.

20. Ghosh, P.K., Khan, M.S., Abichandani, R.K. (1976): Effect of short-term water deprivation in summer on Marwari sheep. J. Agric. Sci., 87: 221-223.

21. Giger-Reverdin, S., Gihad, E.A. (1991): Water metabolism and intake in goats. In: Morand-Fehr, P., (ed), *Goat Nutrition*, pp. 37-45. Wageningen, Netherlands.

22. Hossaini-Hilali, J., Benlamlih, S., Dahlborn, K. (1994): Effects of dehydration, rehydration, and hyperhydration in the lactating and non-lactating black Moroccan goat. Comp. Bioch. Physiol., 109A: 1017-1026.

23. Ismail, E., Hassan, G.A., Abo-Elezz, Z., Abd El-latif, H. (1996): Physiological responses of Barki and Suffolk sheep and their crossbreeds to dehydration. Egypt. J. Anim. Prod., 33: 89-101.

24. Kay, R.N.B. (1997): Responses of African livestock and wild herbivores to drought. J. Arid Environ., 37: 683–694.

25. Little, W., Sansom, B.F., Manston, R., Allen, W.M. (1978): The effects of reducing the water intake of lactating dairy cows by 40% for 3 weeks. Anim. Prod., 27: 79-87.

26. Maltz, E., Shkolnik A. (1984): Lactational strategies of desert ruminants: the Bedouin goat, ibex and desert gazelle. Symp. Zool. Soc. Lond., 51: 193-213.

27. Maltz, E., Olsson, K., Glick, S.M., Gyhrquist, F., Silanikove, N., Choshniak, I., Shkolnik, A. (1984): Homeostatic responses to water deprivation or hemorrhage in lactating and non-lactating Bedouin goats. Comp. Bioch. Physiol., 77A: 79-84.

28. Mengistu, U., Dahlborn, K., Olsson, K. (2007): Mechanisms of water economy in lactating Ethiopian Somali goats during repeated cycles of intermittent watering. Anim., 1: 1009-1017.

29. Olsson, K. (2005): Fluid balance in ruminants: adaptation to external and internal challenges. Ann. New York Acad. Sci., 1040: 156-161.

30. Olsson, K., Dahlborn, K. (1989): Fluid balance during heat stress in lactating goats. Q. J. Experi. Physiol., 74: 645-659.

31. Olsson, K., Maltz, E., Glick, S.M., Fyhrqist, F., Shkolnik, A. (1983): On the control of water balance in lactating and non-lactating Bedouin goats. Acta Physiol. Scand., 118: 297-299.

32. Puri, G., Kataria, N. (2004): Creatinine clearance in Marwari goats during water deprivation and rehydration. Indian J. Anim. Heal., 43: 1-5.

33. Robertshaw, D., Dmi'el, R. (1983): The effect of dehydration on the control of panting and sweating in the black Bedouin goat. Physiol. Zool., 56: 412-418.

34. Schleger, A.V., Turner, H.G. (1965): Sweating rates of cattle in the field and their reaction to diurnal and seasonal changes. Aust. J. Agric. Res., 16: 92-106.

35. Senay, L.C. (1979): Temperature regulation and hypohydration: A singular view. J. Appl. Physiol., 47: 1-7.

36. Shkolnik, A., Choshniak, I. (1985): Physiological responses and productivity of goats. In: Yousef, M.K. (ed.), *Stress Physiology in Livestock, vol. II, Ungulates*, pp. 39–57. CRC Press Incorporation, Boca Ration, FL.

37. Silanikove, N. (1994): The struggle to maintain hydration and osmoregulation in animals experiencing severe dehydration and rapid rehydration: the story of ruminants. Exp. Physiol., 79: 281–300.

38. Silanikove, N. (2000): The physiological basis of adaptation in goats to harsh environments. Small Rumin. Res., 32: 181-193.

39. Singh, M., More, T., Rai, A.K., Karim, S.A. (1982): A note on the adaptability of native and cross-bred sheep to hot summer conditions of semi-arid and arid areas. J. Agric. Sci., 99: 525-528

40. Statistical Analysis Systems. (1996): *Users Guide: Statistics*. SAS Institute for statistical analysis, Cary, NC.

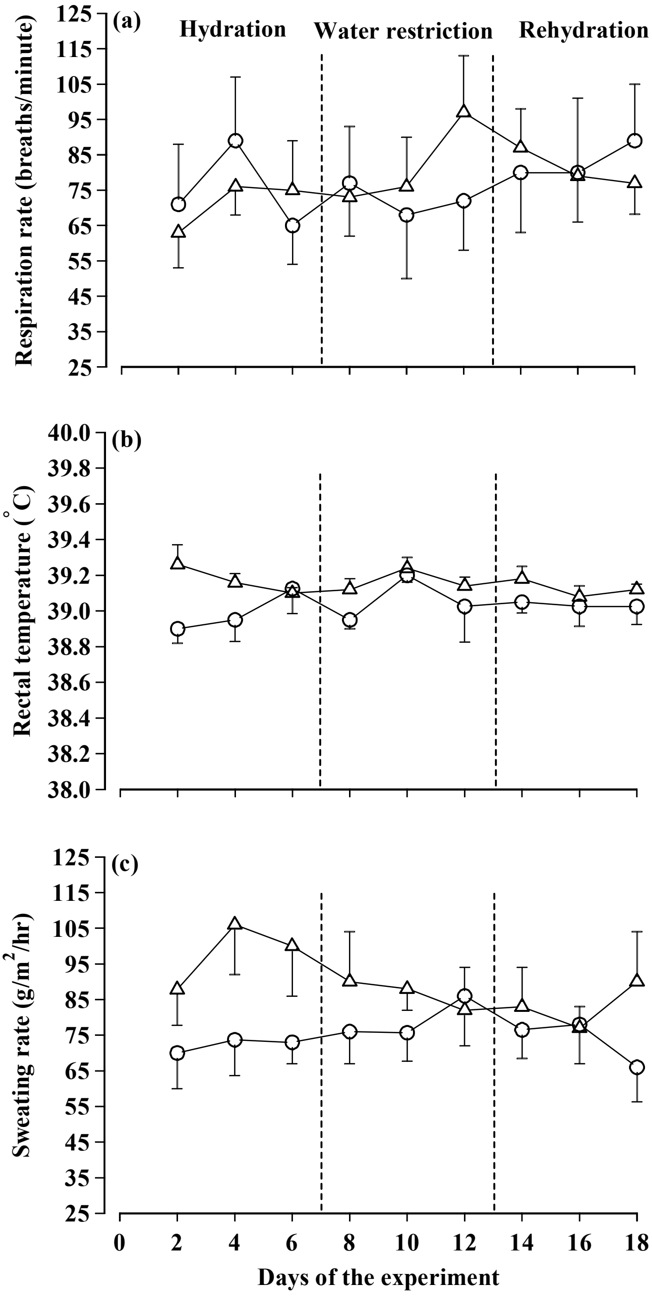

Figure 1. Respiration rate (a), rectal temperature (b), and sweating rate (c) in lactating Aardi goats during control, 50 (Δ) and 25% (○) water restriction and rehydration.

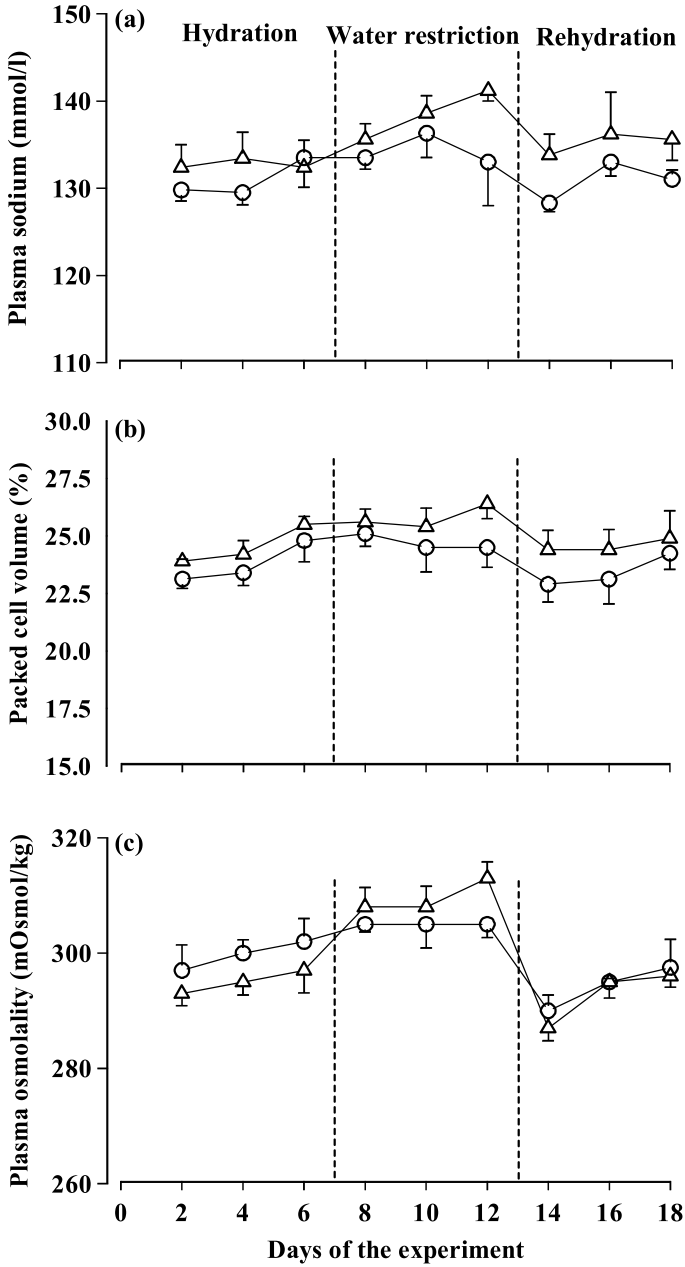

Figure 2. Plasma levels of sodium (a), packed cell volume (b), and plasma osmolality (c) in lactating Aardi goats during 50 (Δ) and 25% (○) water restriction and rehydration

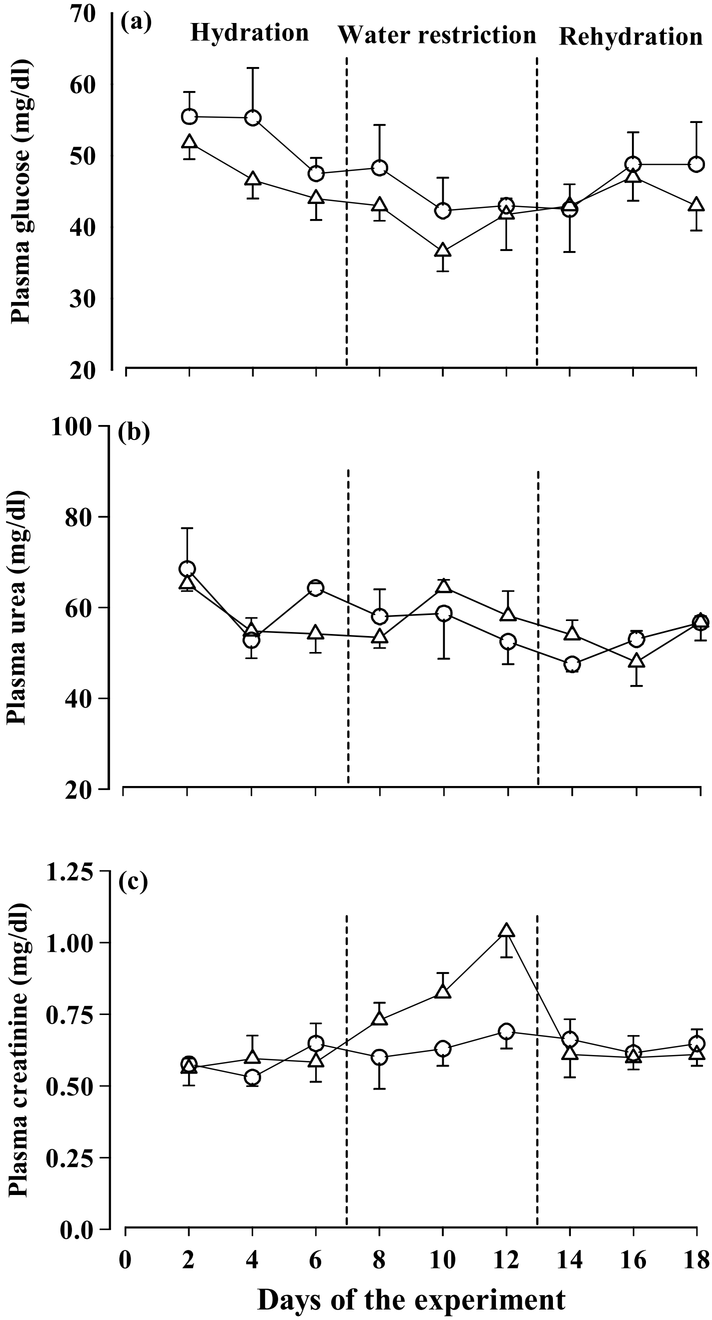

Figure 3. Plasma levels of glucose, (a), urea (b), and creatinine (c) in lactating Aardi goats during control, 50 (Δ) and 25% (○) water restriction and rehydration

تأثير تقييد الماء على التنظيم الحراري وبعض المكونات الكيموحيوية في الماعز العارضي الحلوب خلال الظروف الجوية الحارة

محمد عبد الله العامر

قسم الإنتاج الحيواني والسمكي، كلية العلوم الزراعية والأغذية
جامعة الملك فيصل، الأحساء، المملكة العربية السعودية

الملخص :

أجريت هذه الدراسة لتقييم تأثير تقييد الماء على بعض المتغيرات الفسيولوجية في الماعز العارضي خلال الفترة المبكرة للإدرار.قسمت التجربة إلى ٣ فترات بطول ٦ أيام لكل منها، وهي فترة المقارنة، تقييد كمية الماء و إعادة الارتواء. تم تقسيم الماعز خلال الفترة المبكرة من الإدرار إلى مجموعتين، أحدها تحصلت على ٥٠٪ من كمية الماء (عدد ٥ حيوانات)، والمجموعة الأخرى (عدد ٤) حصلت على تقييد للماء بنسبة ٢٥٪ وذلك بالنسبة للماء المستهلك خلال فترة المقارنة . لم يتأثر معدل التنفس وإفراز العرق بتقييد كمية الماء المستهلكة وبالتالي تمت المحافظة على درجة حرارة الجسم بصورة ثابتة. أدى تقييد كمية الماء بنسبة ٥٠٪ إلى زيادة مطردة في مستوى الصوديوم والاسموزية للبلازما مقارنة مع المجموعة الأخرى وهذا يعتبر مؤشر لزيادة تركيز بعض مكونات الدم نتيجة لفقد السوائل من حيز البلازما. من ناحية أخرى لم يتسبب تحديد كمية الماء في حدوث أي تغييرات واضحة في تركيز كل من الجلوكوز واليوريا في البلازما وحجم خلايا الدم المضغوطة . ولكن لوحظ حدوث زيادة تدريجية للكرياتينين في البلازما مع التقييد بنسبة ٥٠٪، وهذا مؤشر لانخفاض معدل الترشيح الكبيبي. هذه الدراسة تشير إلى أن الماعز العارضي يمكن أن تتحمل النقص المتواصل للماء وبنسبة ٥٠٪ من الكمية المستهلكة خلال الإدرار مع الحد الأدنى من التغيرات الفسيولوجية وذلك عند اقترن ذلك بارتفاع درجة الحرارة في البيئة المحيطة.