Egyptian J. Anim. Prod.(1993) 30(1):63-70.

A COMPARATIVE STUDY ON WATER ECONOMY OF DESERT GOATS AND SHEEP IN EGYPT

N.A. El-Sayed, A.A. Azamel and M.M. El-Ganaieny

Department of Animal Production, Desert Research Center, Matareya, Cairo, Egypt

SUMMARY

Five desert Barki rams and 5 Barki bucks at 3-4 year of age were used to study the species difference in water requirement and utilization over winter, spring, summer and autumn, 1989. Average daily total water input (drinking, dietary and metabolic water) versus total water excretion (urinary and faecal water) were individually measured per a comparable unit body mass (Ml/kg $W^{0.82}$). Then, evaporative water loss could be seasonally calculated. Haematocrit percentage was also measured for all the animals.

Although goats consumed slightly more water along the different seasons, they excreted lower water when compared to sheep. However, the estimated evaporative water loss was higher ($P<0.5$) in bucks than in rams, value being 103.7, 133.8, 145.4 and 137.4 ml/kg $w^{0.82}$ for bucks and 94.4, 118.80, 112.8 and 105.8 for rams during winter, spring, summer and autumn, respectively.

Season had highly significant ($P<0.01$) effect on input-output water equilibrium as well as on haematocrit percentage irrespective of the species of animals. Haematocrit % was slightly higher in sheep than in goats.

Keywords: Water economy, Sheep, Goats

Water is a essential factor for the existing livestock in hot-dry desert areas. Water is needed not only to enhance ingestion of the mostly dry food but also is required for thermoregulation function in the hot climates (Macfarlane, 1968). The water economy of animals although is be inversely related to feed intake and growth rate (Wilson, 1970), may assist in Their survival when water is rarely available.

Issued by Egyptian Society of Animal Production.

There are considerable genetic differences among different ruminant species in water utilization. Camels sheep and goats, in descending order, are economical users for water turning over much less as compared to the water-depended cattle and buffaloes (Kamal et al., 1978 and Mokhtar et al., 1988). However, the absolutely low water demands and more flock-size flexibility give sheep and goats some advantages over the large ruminants.

Data on seasonal water requirements of sheep and goats in Egyptian desert are rather limited, The present work aimed at studying of the effect of season on the species difference in water economy and utilization by sheep and goats under desert conditions.

MATERIAL AND METHODS

Animals

Five adult desert Barki rams and 5 Barki bucks at 3-4 years of age were used to study the species difference in water requirement and utilization throughout the different seasons. These animals were raised on Maryout Experimental Station, Research Center, located at 35 km. south west of Alexandria (32°N latitude). The Station flock usually is allowed to graze outdoors in the pasture and then supplemented indoor with the concentrate mixture at a rate of 1/4-1/2 kg/head/day. Animals were shorn once a year (in may) according to normal management of the flock.

Experimentation and measurements

The study included 4 metabolic experiment which were carried out in January, April, July and October, 1989, representing winter, spring, summer and autumn, respectively. On each experiment, animals were individually put in metabolic cages for 20 days (15 days for adjustment and 5 days for samples collection). Animals were offered maintenance rations according to their initial body weights at the beginning of each experiment (ARC, 1965). Rations consisted of concentrate mixture (50% cotton seed cake, 15% yellow maize, rice polish, 12% wheat bran, 2% limestone and 1% common salts) and berseem (Trifolium alexandrinum) hay at ratio of 1:1. During the collection period feed and free water intakes, urine volume and faeces excreted were measured daily. Cages type used allowed catching the faeces separately from the urine which was collected in an attached glass container.

Moisture contents of feeding stuffs, faeces and urine were determined by drying fresh daily samples of each at 105°c to constant weight. Thus, totals of each of dietary, Faecal and urinary water could be obtained. Through digestibility trials all digestible nutrients were determined. Then, metabolic water gained was estimated

by multiplying the amounts of digestible nutrients by the oxidation water resulting from 1 gm of each (A.O.A.C., 1975). Evaporative water loss (EWL) was calculated by subtracting the sum of water excreted (WE) (faecal + urinary) from total water input (TWI) (drinking + dietary + metabolic). These procedure based on the assumption of the stability of body weight during the collection period.

Blood samples were drown to measure haematocrit percentage (Ht%) using a microhaematocrit centrifuge. Indoor mean ambient temperature °C (AT) and relative humidity (RH%) were recorded at 08.00 and 14.00 hr over each experimental period.

Statistical procedure

Data of the present study were collected on the same groups of animals over the different seasons. Therefore, such data were subjected to the analysis of variance using the split-plot repeated measures design (Kirk, 1968).

RESULTS AND DISCUSSIONS

Water balance and utilization

On the average, water input per unit body mass was slightly lower (-8.4%) for rams than for bucks)173.4 vs. 187.9 ml/kG$^{0.82}$). Such species difference in water requirements was in fact due to the high contrast of drinking water whereas dietary and metabolic water intakes were almost similar in both species (Table 1).

Table 1. Average body weight (BW),body mass(BM),total water intake (TWI), water excretion (WE), evaporative water loss (EWL), dry matter intake (DMI) and haematocrit percentage (Ht %) for rams and bucks during different seasons

Item	Winter		Spring		Summer		Autumn		Mean		SE	
	Ran	Buck	Ran	Buck	Ran	Buck	Ran	Buck	Ran	Buck	1	2
BW (kg)	58.4	45.5	67.4	49.4	64.6	49.7	64.1	45.5	63.6	47.5	0.95	0.82
BM(kgWB$^{0.02}$)	28.1	22.9	31.6	24.5	30.5	24.6	30.3	22.9	30.1	23.7	0.50	0.22
TWI(ml/kg BW$^{0.02}$)	162.4	168.3	182.6	202.9	175.0	204.5	173.7	176.0	173.4	187.9	14.2	4.9
- Drinking	148.3	154.5	169.5	189.8	162.3	190.3	159.5	162.6	159.4	174.3		
- Dietary	7.5	7.0	6.0	6.1	7.3	7.0	7.9	7.4	7.3	6.9		
- Metabolic	6.6	6.8	6.7	7.0	5.4	7.2	6.3	6.0	6.3	6.7		
WE(ml/KG BW$^{0.02}$)	68.1	64.6	63.8	69.1	62.2	59.1	69.9	38.6	66.0	57.9	8.0	2.9
- Urinary	42.3	48.3	44.3	52.2	38.6	38.9	44.0	25.3	42.7	41.2		
- Faecal	25.8	16.3	19.5	16.9	23.6	20.2	25.9	13.3	23.7	16.4		
DMI(ml/kg BW$^{0.02}$)	94.4	103.7	118.8	133.8	112.8	145.4	103.8	137.4	107.9	130.1	6.9	4.8
DMI(ml/ BW$^{0.02}$)												
- kg/heard/day	1.258	0.966	1.507	1.109	1.412	1.085	1.391	0.922	1.392	1.021	0.03	0.02
- g/kg BW$^{0.75}$/day	59.5	55.1	64.1	59.5	62.0	58.0	61.4	52.6	61.8	56.3	5.7	5.5
Ht %	43.9	43.9	38.2	33.2	35.0	33.0	45.0	40.0	40.5	37.5	1.0	1.5

1, Standard error of species mean
2, Standard error of season mean

Previously, Barki ewes and Baladi does showed a similar species trend in free water intake (Mokhtar et al., 1989. These results are in disagreement with Macfarlane (1964) and Aganga et al. (1989) who reported that goats utilize significant ($P<0.01$) less water than sheep. Species difference in water input was more declared in summer (17%) and spring (11%) than in winter (4%) and autumn (<2%). However, the results of Yagil et al. (1988) revealed that sheep were more eager than goats for drinking water seeking for shade during grazing in summer.

Regardless of animal species, water turnover rate (as expressed by water intake per body unit per 24 hr, Macfrlane, 1968) was higher ($P<0.01$) in summer, spring and autumn (190, 193 and 175 ml/gk$^{0.82}$/day) than in winter (105 ml/kg/w$^{0.82}$/day) reflecting the impact of seasonal AT on water needs by desert animals. Average indoor at 14.00 hr was found to be 31.9, 29.9, 24.8 and 16.3°C in summer, spring, autumn and winter, respectively. The respective values of RH % were 86.7, 60.8, 83.3 and 66.7%. The high water consumption might be an urgent behaviour to offset the concomitant high EWL during the warmer seasons. Blaxter et al. (1959) found that EWL in sheep was relatively constant up to 25°C but rose steeply above that AT.

On the other hand, rams excreted 13.1% more water than bucks did (66.0 vs. 57.9 ml/kg$^{0.82}$). Difference percent was more notable in faecal moisture (14.1%) than in urinary water (<3%). This result is supported by that of Aganga et al. (1989) who reported that goats produced drier faeces than sheep. However, average EWL was significantly ($P<0.05$) higher in goats than sheep (130 vs. 108 ml/kg$^{0.82}$) as shown in Table 1. On the contrary, Aganga et al. (1989) found that EWL per unit metabolic body weight was higher in sheep than in goats (162.4 vs. 120 ml/kg$^{0.75}$. The present study indicated that though goats drank slightly more they excreted less water(in both faeces and urine) in order to devote more water for temperature regulation function, as compared to sheep. In other words, EWL and WE values represented, respectively, 70 and 30& of total water by goats, whereas the respective figures for sheep were 62 and 38%.

It is worthy to note that in both species studied EWL value exceeded the sum of water excreted in faeces and urine. As desert ruminants, sheep and goats seem to utilize not only lesser water than cattle (400 ml/kg$^{0.82}$/24 hr) as reported by Macfarlane, (1968) but also devote proportionally greater part for evaporative cooling. Though a large ruminant, camels are superior to other species in this respect (kamal et al., 1978 and Mokhtar et al., 1989)

Haematocrit percentage:

Bucks kept slightly lesser Ht% as compared to sheep (Table 1). However, Ht % was considerably variable over the different seasons.

Season had highly significant ($P<0.01$) effect on Ht%. Haematocrit % is a function of both count and size of the cellular components of blood. The significant ($P<0.01$) lower Ht% both in summer and spring could be due to the high water intake in such seasons (Table 1). Mokhtar et al. (1989) reported a state of haemo-dilution and subsequent low Ht% for the daily watered Braki ewes as compared to those watered each 3 days (33.8 vs. 37.9%). In Barki ewes, Khalil (1990) found low but similar Ht% values during summer and winter (23.8 vs. 23.4%). Although diluted blood, drinking water also resulted in significant increase in the size of erythrocytes of sheep (Yagil et al., 1988). Accordingly, they found no change in Ht% before and after drinking. On the other hand, the same authors reported that sheep erythrocytes were significantly larger than those of goats. This may explain the higher Ht% of sheep than that of goats in the present study (40.5 vs 37.5%).

Body weight changes:

Although the animals were offered maintenance rations during the experimental period, they were left freely to the station flock between experiments. As shown in Table (1), average BW of both species groups had undergone significant changes over different seasons, being higher in spring and summer and lower in winter. In both species, BW was around 10% higher in summer than in winter. Such fluctuation in BW could be attributed to some reasons. The higher water turnover rate ($TWI/kg^{0.82}$ hr) due to the relatively higher AT in spring and summer, may result in increased extracelluar fluid and total body water during such warmer periods than in winter. For desert animals, The more water passes through the body the more water retained particulary under heat stress. (Macfarlane, 1968). Accordingly, the TBW of sheep is likely to be 20% lower in winter than during summer. The increase in TBW resembles as thermal regulating mechanism because of the high specific heat of water . Feeding conditions during different seasons also might be involved in BW changes since feed and water intakes are reported to be closely linked (Wilson, 1970). The comparable values of DMI were slightly higher in summer and spring than in winter (Table 1).

CONCLUSION

In comparison with sheep,goats consumed slightly more water but significantly economized water in excretion for physiological regulation. Lack of significant species X season interactions for all

the traits studied indicates that both sheep and goats responded similarly to the significant effect of season. The choice between the two species needs to consider availability of water in the desert particularly the hot season.

REFERENCES

Aganga, A.A., N.N. Umunna, E.O. Oyedipe and P.N. Okoh, 1989. Water balance of Maradi goats and Yanasaka sheep in Nigeria. The small Ruminant Research Network, International Livestock Center for Africa, June, 1989.

A.O.A.C., 1975. Official methods of analysis, 11th Ed., Washington, D.C.

A.R.C., 1965. The nutrient requirements for livestock 2. ruminants. Agricultural Research Council, London.

Blaxter, K.L., N. McC Graham, F.W. Wainman and D.G. Armstrong, 1959. Environmental temperature, energy metabolism and heat regulation in sheep.II. The partition of heat losses in closely clipped sheep. J. Agric. Sci., 52: 25.

Kamal, T.H., I.M. El-Banna, E.A. Kotby and M.A. Ayad, 1978. Effect of hot climate and management on water requirements and body water in farm animals using tritiated water. Arab. J. Nuclear Sci. and App., 11; 10.

Khalil, M.H., 1990. Effect of water deprivation and wool coat length on body fluid compartments in Barki sheep. Egyp. J. Anim. prod., 27: 89.

Khan, M.S., 1983. Mechanism of body water regulation in Indian desert donkey. Ann. Arid. Zone, 22:319.

Khan M.S., T.O. Sastdharan and P.K. Ghosh, 1979. Water regulation in Barmer goat of the Rajsthan desert. Experimentia, 35: 1185.

Kirk, R.E., 1968. Experimental design procedure for the Behavioural Science. Brooks/Cole Publishers Company, Belmont, California USA, PP, 245.

Macfarlane, W.V.,1964.Terrestrial animals in the dry heat: Ungulates. in Handbook of physiology- Environment. Ed. B.R. Dill, Washington, D.C/. Am. Physiol., Soc., PP 309.

Macfarlane, W.V.,1986.Adaptation of ruminants to tropics and deserts. In: Adaptation of Domestic Animals. Ed. by E.S.E. Hafez, Lea and Febiger, Phildephia, USA, PP. 164.

Mokhtar, M.M., A.A. Azamel, and A.A. Younis, 1989. Responses of desert Barki sheep to different environmental constraints. The third Egyptian British Conference on Animals, Fish and Poultry production. Alexandria, Egypt, 7-10 October, 1989.

Mokhtar, M.M., E.E. EL-Hassanien, A.A. Younis, and A.A. Azamel, 1988. Physiological responses in camels, sheep and goats under hydrated and dehydrated conditions. International Symposium on the Constraints and Possibilities of ruminant production in the dry Subtropics, Cairo, Egypt, 5-7 November, 1988.

Wilson, A.D.,1970.Water economy and food intake of sheep when watered intermittently. Aus. J, Agric. Res., 12: 273.

Yagil, R., Van Creveld, C., Oren T., Rogel, A. and Arnon, A. 1988. Responses of Awassi sheep and Black goats to grazing in summer. Int. J. Anim. SCi., 3: 181.

دراسة مقارنة في اقتصاد استخدام الماء بواسطة الماعز والأغنام الصحراوية في مصر

نبيل عبد العظيم السيد - عبد الحميد أحمد أزامل - محمود محمد الجنايني
شعبه الانتاج الحيواني والدواجن - المطريه - القاهره - مصر

هدفت هذه الدراسه الي عقد مقارنه بين الماعز والأغنام البرقي الصحراويه بمصر من حيث الاحتياجات المائيه ومصارف خروجها من الجسم عبر فصول السنه المختلفه ، وكذلك دراسه تأثير فصل السنه علي كل الميزان المائي وبعض مقاييس التأقلم بالدم.

استخدم لغرض البحث خمسه تيوس وخمسه كباش بالغه علي عمر ٣ - ٤ سنوات مختاره عشوائيا من قطيع محطه بحوث مربوط التابعه لمركز بحوث الصحراء ، حيث تم عليها تنفيذ أربع تجارب هضم خلال شهور يناير ابريل ، يوليو ، اكتوبر لسنه ١٩٨٩ - مده كل تجربه ٢٠ يوم (١٥ يوم تمهيدي + ٥ أيام لجمع العينات). تم حساب كل الماء الداخل للجسم (في الشرب والعليقه والماء التمثيلي) في مقابل الماء المفرز منه (في البول والروث) ، ثم حسب الماء المفقود بالبخر باستخراج الفرق بين الماء الداخل والمفرز (علي أساس ثبات وزن الحيوان خلال فتره الجمع حيث كانت تقدم علائق حافظه للحيوانات) - كما قدرت نسبه المكونات الخلويه بالدم (هيماتوكريت).

رغم ان التيوس استهلكت ماء لكل وحدة من الجسم اكثر قليلا الا انها افرزت ماء اقل مقارنة بالكباش ، وعليه كان الماء المفقود من الجسم عن طريق البخر اكثر معنويا (٠,٥٠ مستوى معنوى) فى الماعز عنه فى الاغنام ، وبلغت القيم ١٠٣,٧ ، ١٣٣,٨ ، ١٤٥,٤ ، ١٣٧,٤ مل/كجم وزن تمثيلى للماعز ، ٩٤,٤ ، ١١٨,٨ ، ١١٢,٨ ، ١٠٣,٨ ، للاغنام خلال الشتاء ، الربيع ، الصيف ، الخريف على التوالى. وكان حجم الهيماتوكريت (لكل وحدة من وزن الجسم) اعلى قليلا فى الاغنام عنه فى الماعز .

كان للفصل السنوى تاثيرا عاليا على ميزان الماء وعلى نسبة الهيماتوكريت بصرف النظر عن النوع الحيوانى ، حيث تباينت درجة الحرارة الجوية والرطوبة النسبية بين الفصول المختلفة.

اوضحت الدراسة ان الماعز كانت اكثر تقتيرا من الاغنام فى افراز الماء فى البول والروث باستخدامه فى اغراض فسيولوجية اخرى مثل تنظيم حرارة الجسم .