WATER MEDICATION TO IMPROVE THE HUSBANDRY OF GRAZING SHEEP AND CATTLE

R.G.A. Stephenson* and P.S. Hopkins**

Summary

Water medication is an attractive concept with the potential to improve the health and production of sheep and cattle. Compulsory and uniform intake of medicaments on a liveweight basis whenever sheep and cattle drink from a trough is central to the concept. A medicament includes any substance which has the potential to improve livestock husbandry. The current success of water medication is presented by way of results of urea supplementation and parasite control experiments. The advantages and limitations together-with some practical considerations for commercial adoption are discussed.

I. INTRODUCTION

Water medication is an attractive concept for providing a uniform and compulsory dose of a range of substances to livestock where controlled waters are available. Previous studies (Stephenson et al. 1981 and 1984) have successfully administered urea via drinking water to lambing ewes under grazing conditions. The advent of dispensers. capable of metering substances into drinking water at a pre-determined rate makes water medication a feasible on-farm proposition (Stephenson 1983). The concept, potential advantages and limitations of water medication and types of medicaments that have been used successfully are discussed in this paper. The paper also presents information on the practical considerations relating to the variability in intake between sheep under extensive conditions.

II. THE CONCEPT

Irregular intake of supplement has been the major problem encountered in all voluntary supplementation methods (Entwistle and Knights 1974; Nolan et al. 1974 and 1975; Dove 1984). This is particularly so in extensive grazing situations and can lead to failure of a supplementation programme and a waste of money. Medication of livestock via a controlled water source ensures that animals are dosed regularly each time they drink. This factor obviously implies that seasonal and regional considerations will determine the extent to which this type of husbandry can be used with success. For example, seasonal constraints may dictate that this form of supplementation is not possible during the wet season. During the following dry season there may be periods when strategic supplementation for production, and subsequently crisis supplementation for survival have practical appeal before the intervention of the next wet.

The use of drinking water as a vehicle for a supplement ensures that all medicament is received on a liveweight basis; i.e., dosing is commensurate with live weight since, in any particular set of environmental circumstances, sheep of a particular physiological state drink according to metabolic requirements (MacFarlane and Howard 1970).

Any substance which has the potential to improve either animal health or production can be classed as a medicament. This includes substances that

* Sheep and Wool Branch, ** Beef Cattle Husbandry Branch, Queensland Department of Primary Industries, G.P.O. Box 46, Brisbane 4001

are water soluble as well as insoluble substances that can be stabilised in a dispersible form. The supplementation level can range from a few micrograms (e.g., trace elements) to several grams per litre of drinking water unless palatability problems are encountered. These medicaments can be provided without carrier substances.

III. POTENTIAL ADVANTAGES

(a) Mustering costs associated with livestock management procedures such as internal and external parasite control could be reduced, or in some situations eliminated where medicaments for parasite control can be added to the drinking water. While the cost of mustering varies considerably, 30 c per sheep is applicable in some extensive grazing districts; cattle mustering costs are obviously higher.

(b) Animal stress associated with mustering and holding in yards is also eliminated. This is important in dry seasons when poor pasture is causing liveweight loss. Any procedure which avoids a net tissue loss is advantageous. Similarly, water medication could lessen the problems of lamb mismothering and ewe losses due to pregnancy toxaemia if the necessity to muster is obviated. Alternatively, in cattle it may be possible to induce weaning by adding flavours to the drinking water of lactating cows which impart a milk taint which discourages sucking. A weaner management package could ensue.

(c) Reduced dust contamination in the wool as a result of less mustering and yarding will improve the value of the wool clip. Dusty yards can reduce wool yields by 1 to 3%, resulting in discounts at auction.

(d) Current research is also examining the extent to which water medication can be used to restore muscle glycogen levels in cattle transported for slaughter. Improving aspects of meat quality is obviously the objective in this case.

(e) Medication can be dispensed into a reservoir rather than into a trough. Dispensing medicament into a central reservoir supplying a number of troughs would be the most convenient and economical way to set up this procedure for sheep and cattle management.

(f) The capital cost per sheep per day is quite low. The cost of one particular commercial dispenser is approximately $600 and its average lifetime is 5 years. In a flock of 2 000 sheep, dosed for 60 days each year, the capital cost for the dispenser would be $1.00 per 1 000 sheep for each day of medication or 6 cents/sheep/year. If commercial blocks were used, approximately 40% of 50 g intake/sheep/day being made up of carrier substances, then the extra non-productive expense is 30-90 cents/sheep for a 60 day supplementation period. Other comparisons with cattle are equally significant.

(g) Medication can be initiated immediately after determining the need for treatment. This is not always possible with traditional procedures involving voluntary intake systems and the associated education procedures which take time. The simple procedure of harnessing the medication system to a water supply is labour saving both at the time of installation and afterwards, allowing other farm commitments (e.g., planting or harvesting operations) to be met. Importantly, medication can reduce or prevent production losses immediately.

IV. LIMITATIONS

(a) Topographical limitations such as creeks and other open water facilities will preclude the use of water medication in some paddocks.

(b) Water medication may not be feasible during the wet season when surface water is available.

(c) Additional capital outlay is required to equip open waters with a trough and dispenser and the maintenance of this equipment.

(d) Some refinements in dispenser designs may be necessary to adequately cover the practical needs of sheep and cattle producers wishing to add an array of medicaments ranging from relatively expensive concentrate (e.g., drenches) to large volumes of supplements.

(e) Urea toxicity is a potential problem and therefore appropriate management considerations are just as necessary when providing urea through the water as in any conventional form. The advent of a cheap on-the-spot urea test for measuring trough concentrations provides a means for monitoring supplementation rates by the primary producer which can minimise the risk.

V. TYPES OF MEDICAMENT

Medicaments that have been successfully used include nutrients, drenches, blowfly compounds and wool growth promotants.

(a) Nutrients

Sheep requirements for nitrogen and minerals during the dry season have been estimated in studies at "Toorak" (Lorimer 1978 and 1981) and Charleville (McMeniman et al. in press). It is now known that lactating ewes grazing mature Mitchell grass pastures require a daily supplement of 3 to 4 g nitrogen, and 0.5 to 1 g sulphur to maintain adequate performance from July/August onwards in a normal year when standing pasture is steadily deteriorating. Providing nitrogen and sulphur in the drinking water improves ewe milk yield and lamb growth and survival.

Tables 1, 2 and 3 summarise some of the production results obtained in several experiments, and also highlight the difference in rumen ammonia values between supplemented and control ewes, and between lactating and non-lactating ewes.

The effect of the intake of urea on ammonia concentrations in rumen liquor of pregnant ewes grazing mature pastures was measured (Table 4). The concentration of ammonia in the rumen varied significantly between sampling before and after drinking. Highest concentration was measured approximately one hour after ewes were observed drinking from the trough. The concentration on day 2 (i.e., 23 hours after the last intake of urea) was similar to the pre-drinking concentration on day 1; however, values were significantly less ($P \leqslant 0.05$) on day 4, approximately three days after the last intake of urea.

Recent research with beef cattle is highlighting the potential for administering urea to the species though this work'is in its developmental phase.

Table 1. Feed and nitrogen intake, milk yield and liveweight loss of ewes, and birth weight and growth rate of lambs

Attribute	Group 1 Flinders grass		Group 2 Flinders + urea (water 2.2 g/L)		Group 3 Flinders + urea (1% W/W)	
	Mean	SE	Mean	SE	Mean	SE
Ewes lambed (n)	20		20		20	
Feed intake (g/d)	900^{a}	34.0	1 190^{b}	28.0	1 250^{b}	26.0
Nitrogen intake (g/d)	8.1^{a}	0.28	15.1^{b}	0.20	17.5^{c}	0.19
Ewe liveweight loss (kg)	11.8^{a}	0.70	8.2^{b}	0.52	8.8^{b}	0.59
Milk yield (ml/4 h)						
Day 1	78^{a}	7.4	ND		108^{b}	12.1
Day 11	58^{a}	8.0	ND		96^{b}	9.4
Day 21	42^{a}	3.4	ND		78^{b}	6.3
Mean	59^{a}	4.1	ND		94^{b}	9.1
Lamb survivors (n)	12		16		16	
Lamb birth weight (kg)	2.9^{a}	0.11	3.2^{b}	0.10	3.2^{b}	0.08
Lamb growth rate (g/d)	35^{a}	7.1	81^{b}	8.4	84^{b}	7.5

Parameters with differing superscripts differ; $^{a-b}$ and $^{b-c}$ $P \leq 0.05$, $^{a-c}$ $P \leq 0.01$.

Table 2. Rumen ammonia concentration and liveweight change of pen and paddock ewes, and lamb growth rate with and without urea supplementation

Experiment	Rumen ammonia* (mg%)		Ewe liveweight change (g/d)		Lamb growth rate (g/d)	
	Mean	SE	Mean	SE	Mean	SE
Pen						
Urea supp+ ewes (wet)	5.4^{a}	0.56	-73^{a}	7.1	103^{a}	5.8
Control ewes (wet)	1.0^{c}	0.15	-135^{c}	10.3	71^{c}	6.1
Paddock						
Control ewes (wet)	1.4^{a}	0.06	-170^{a}	30.7	39	7.2
Control ewes (dry)	3.6^{c}	0.80	-60^{b}	21.6		
Paddock						
Urea supp+ ewes (wet)	6.8^{a}	0.38	-28^{a}	1.9	111^{a}	6.9
Control ewes (wet)	4.1^{c}	0.54	-100^{c}	7.1	86^{b}	7.1

Paired parameters with differing superscripts differ; $^{a-b}$ $P \leq 0.05$ $^{a-c}$ $P \leq 0.01$.

* Sampled between 0900 and 1100 h (2-3 h after feeding)
\+ Urea supplemented via drinking water, 2.5 g/litre

Table 3. Rumen ammonia concentration, liveweight change, and milk yield of ewes with and without urea supplementation

Attribute	Rumen ammonia (mg%)		Liveweight change (g/d)		Milk yield (ml/day)	
	Mean	SE	Mean	SE	Mean	SE
Lactating ewes						
supplemented	5.1[a]	0.31	n.d.		539[a]	34.1
control	1.9[c]	0.20	n.d.		442[b]	31.7
Non-lactating ewes						
supplemented	6.6[a]	0.33	-59*	10.1		
control	5.7[a]	0.78	-26	5.3		

* Paddock bias favoured the control animals

Paired parameters within columns with different superscripts differ; [a-b] $P \leqslant 0.05$ [a-c] $P \leqslant 0.01$.

Table 4. Rumen ammonia concentrations (mg per 100 ml liquor) of pregnant ewes supplemented with urea via the drinking water

Sheep No.	Day 1* 9.30 a.m.	Day 1* 11.30 a.m.	Day 2 9.30 a.m.	Day 4 9.30 a.m.
1	6.7	17.1	9.4	4.9
2	11.7	17.9	13.3	4.7
3	9.6	15.3	9.8	5.8
4	10.6	22.0	9.2	5.3
5	10.4	20.5	11.1	9.4
6	12.0	16.2	9.9	5.5
7	11.7	29.1	10.6	6.6
8	14.5	16.9	6.8	6.4
Mean ± s.e.	10.9 ± 0.81	19.4 ± 1.59	10.0 ± 0.65	6.1 ± 0.53

* Day 1. All sheep drank urea-supplemented trough water between 1000 and 1020 hours. Samples were taken before and after drinking. Urea supplementation was then discontinued.

(b) Anthelmintic studies

Unpublished studies using the concept of water medication have involved the anthelmintic treatment of grazing sheep. In three experiments (Table 5) the average daily water intake of the mob was calculated the day before treatment. A trough dispenser was then adjusted so that the correct amount of levamisole (8 mg/kg liveweight) was provided in the calculated water intake of each sheep over a 24 hour period. Medication was discontinued after the 24 hour period. In all experiments, the sheep consumed the correct amount of levamisole and the treatment was successful in effectively reducing worm egg counts. This procedure is not a recommended technique; however, it does highlight another potential use of the system. Levamisole has also been used to successfully treat weaner cattle for helminth burdens. This treatment was instituted in an experimental situation using confined animals.

Table 5. Effect of administration of levamisole via drinking water on faecal worm egg counts in grazing sheep

Location of experiment	Worm egg count (eggs per gram)					
	Before treatment			After water medication		
	Mean	SE	(n)	Mean	SE	(n)
"Toorak" Research Station						
Ewes	1 800	68	(20)	<50		(20)
"Croxdale" Research Station						
Ewes	336	74.6	(20)	<50		(18)
Weaners[a] A	113	28.6	(12)	2 290	416.2	(12)
B	132	41.6	(12)	71	20.2	(12)
Dirranbandi co-operator property						
Lactating ewes	550	87	(7)	<50		(20)

[a] Group A were removed from the mob immediately before treatment.
Group B received treatment before all larvae had matured and commenced full egg production (sheep artificially infected 20 days previously).

(c) Blowfly control studies

A study on the effectiveness of providing **Vetrazin*** in the drinking water to control flystrike was carried out at "Toorak". Two groups of susceptible ewes were run in adjoining 260 ha paddocks. Vetrazin was administered to one group via the drinking water. Weekly records were made of the incidence of strike and deaths over a 4 week period. The final result is presented in Table 6.

Other studies carried out in the central and south west sheep districts have had similar encouraging results. Sheep become susceptible to flystrike within forty-eight hours of discontinuing the treatment. However, the speed with which treatment can be instigated is of practicalsignificancein extensive areas, and where other farm operations (e.g., planting or harvesting) have first priority. It must be noted that the medicament is not registered for this purpose.

Table 6. Vetrazin administered to sheep via drinking water (dose rate 3 a.i. mg/kg/d) over a 4 week period

Group	No. of sheep	Dead	Healed
Treated	69 (17)	5	29
Controls	70 (18)	17	3

In brackets: number of flystruck sheep in group at start of experiment.

	(a)	(b)
Mean live weight (kg)	x = 41.7	= 41.6
Mean water intake (ml)	y = 5 440	= 5 260
Regression equation	y = 73.7x + 2 366	= 150x - 981
	r = 0.369	= 0.674
	t = 1.847 $P \leqslant 0.06$	= 2.314 $P \leqslant 0.05$
Mean water intake per kg liveweight	= 131 ± 23.2 (S.D.)	= 130 ± 16.6 (S.D.)
S.D. as a % of mean	= 17.7%	= 12.8%

Similar information was derived for experiment 2, where (a) includes all animals and (b) excludes the data of three sheep (two with the lowest and one with the highest calculated water intakes).

	(a)	(b)
Mean liveweight (kg)	x = 45.3	= 45.1
Mean water intake (ml)	y = 4 230	= 4 210
Regression equation	y = 60.3x + 1 494	= 85.8x + 339
	r = 0.5336	= 0.746
	t = 2.75 $P \leqslant 0.025$	= 4 492 $P \leqslant 0.001$
Mean water intake per kg liveweight	= 93.6 ± 12.0 (S.D.)	= 93.5 ± 8.9 (S.D.)
S.D. as a % of mean	= 12.8%	= 9.5%

The results of these experiments suggest that a good relationship exists between average daily water intake and liveweight. Similar results have been reported by MacFarlane (1975) and Springell (1968) for sheep and cattle respectively grazing under other environments. The standard deviation expressed as a percentage of the mean suggests that uniform intakes of medicaments can be achieved by this method compared with large (100%) variations measured with voluntary supplementation techniques (Entwistle and Knights 1974, and Nolan et al. 1974 and 1975).

(c) Other possible uses

Any soluble compounds which influence rumen function have a potential role as a water medicament. Traditional rumen modifiers, polyethylene glycol and electrolytes come to mind. The use of water flavours which can increase the practical value of a medication procedure are also areas of research which are currently receiving attention.

The role of water medication for the prevention of bloat in both dairy and beef cattle has been documented in the popular press. Claims that it is an effective means of bloat control in beef cattle suggest that this husbandry procedure can be applied under temperate environmental circumstances.

VIII. CONCLUSION

Most farms have some paddocks where drinking water is reticulated to a trough. These paddocks can now be used to advantage for a significant part of each year when appropriate medicaments are administered. Water medication has the potential to significantly improve animal health and production if the practical aspects of the concept are adopted as an integral part of normal livestock husbandry.

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(d) Wool growth studies

Two simple formulations containing DL methionine were designed to be administered via drinking water and to provide protection of the methionine from rumen microbial attack (Stephenson unpublished). The first formulation consisted of a mix of methionine, lipid, and water; the second formulation consisted of a blended mix of methionine, sodium bentonite and water. Average daily water intakes were monitored'and concentrations of the two formulations adjusted if intakes varied over time.

All treatments were added to the drinking water to provide 2.5 g of methionine/sheep/day.

Methionine mixed with lipid or bentonite significantly improved wool production in 8 out of 10 of the treatment periods (Cobon pers. comm.).

VI. PRACTICAL CONSIDERATIONS

(a) Reliability of dispensers

In a collateral investigation of the practical aspects of water medication, Stephenson (1983) describes the operation and reliability of three urea dispensers in terms of providing accurate and uniform amounts of urea to the drinking water.

The mean concentrations (2.9 ± 0.09 g/L and 2.6 ± 0.04 g/L) of urea delivered by the Mark I and liquid urea dispensing units respectively were close to the calculated dose. The range in concentrations (2.59-3.08 g/L and 2.1-2.9 g/L) at different times of the day and at either end of' the trough respectively, provided reasonably uniform daily urea intakes ranging from 6.3 to 8.7 g per ewe.

The stability of urea in a small earth dam of approximately 160 000 litres was monitored over one month. Day 1 and day 30 concentrations (g/L) of surface and bottom water were 1.50, 1.75 and 1.45, 1.52 respectively.

At present there are two trough dispensers commercially manufactured , one in Adelaide, the other in Brisbane.

(b) Water intakes of sheep in south west Queenland

Two paddock experiments were carried out at "Croxdale", Charleville, the first during winter, the second during dry and warmer conditions in early summer. In experiment one, 28 ewes of mixed ages and 3 different shearing dates were used. In experiment two 21 ewes of the same age and wool cover were used. Tritium was infused by jugular catheter (day 0) and sheep were sampled on days 1, 2, 3, 7 and 8 and days 1, 2, 10 and 12 for experiments one and two respectively. Standard sample preparation, water turnover calculation and regression analysis were used.

The following relationships were derived from experiment 1 where (a) includes all animals and (b) includes only 18 with the same shearing date (approximately six months wool cover).

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