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in

Etienne M. (ed.).
Dynamics and sustainability of Mediterranean pastoral systems

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 39

1999
pages 179-182

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=99600070>

To cite this article / Pour citer cet article

Egber A., Landau S., Perevolotsky A., Shlosberg A., Belaich M. **Using lithium chloride to elicit conditioned feed aversion to Ferula communis in ewe-lambs: Preliminary results with vetch hay**. In : Etienne M. (ed.). *Dynamics and sustainability of Mediterranean pastoral systems* . Zaragoza : CIHEAM, 1999. p. 179-182 (Cahiers Options Méditerranéennes; n. 39)



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Using lithium chloride to elicit conditioned feed aversion to *Ferula communis* in ewe-lambs: Preliminary results with vetch hay

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SUMMARY - *Ferula communis* (giant fennel), a poisonous plant which causes haemorrhages, is widespread in Mediterranean rangelands and may claim the lives of up to 5% of sheep grazing on infested rangelands, particularly of ewe-lambs at the first grazing season. Ingestion of giant fennel is not associated with post-ingestive pain. It was theorised that the association of giant fennel and post-ingestive malaise would elicit conditioned feed aversion (CFA) in lambs. Because vetch hay is very palatable, the feasibility of CFA was tested on vetch hay, as phase 1 of the project. Two experiments were carried out with weaned ewe-lambs fed individually with a basic ration of chopped oats hay and pelleted concentrate. In experiment 1, a single dose of 4 g NaCl (control) or LiCl (2, 4 or 6 g) dose in aqueous solution was administered orally synchronously with the first distribution of vetch hay. No aversion to vetch hay was noted in lambs dosed with 2 g LiCl, whereas the intake of vetch was nil until day 3 and day 6 post-dosing in lambs dosed with 4 and 6 g LiCl, respectively. Aversion ceased to be effective in these 2 groups between day 9 to day 16 post-dosing. In experiment 2, double vs. triple administration of LiCl (4g and 6 g) at intervals of 3 days was tested. The higher dose of LiCl was found to be lethal in 7/10 lambs. Double administration of 4 g LiCl was found as effective as triple administration: aversion to vetch was effective until day 19 after 1st dosing.

Key words: Conditioned taste-aversions, sheep, feed intake, *Ferula communis*.

RESUME - "Utilisation du chlorure de lithium pour induire une aversion alimentaire conditionnée envers *Ferula communis* chez des agnelles : Résultats préliminaires avec du foin de vesce". *Ferula communis* (fenouil géant), une plante toxique qui cause des hémorragies, est répandue dans les parcours méditerranéens et peut avoir provoqué la mort de jusqu'à 5% des ovins en pâturage dans la zone infestée, spécialement des agnelles pendant la première saison de pâturage. L'ingestion de fenouil géant n'est pas associée à des douleurs après ingestion. Il a été émis l'hypothèse que l'association de fenouil géant et malaises post-ingestion peut induire l'aversion alimentaire conditionnée (CFA) chez les agneaux. Vu que le foin de vesce est très palatable, on a testé la faisabilité de CFA sur foin de vesce comme phase 1 du projet. Deux expériences ont été réalisées sur des agnelles sevrées et nourries individuellement avec une ration de base de foin d'avoine haché et un aliment concentré granulé. Dans l'expérience 1, une seule dose de 4 g NaCl (témoign) ou LiCl (2, 4 ou 6 g) en solution aqueuse a été administrée oralement en synchronisation avec la première distribution de foin de vesce. Aucune aversion au foin de vesce n'a été notée chez les agneaux recevant les doses avec 2 g LiCl, alors qu'il n'y avait pas d'ingestion de vesce jusqu'au 3ème et 6ème jour post-dose chez les agneaux recevant 4 et 6 g LiCl, respectivement. L'aversion a cessé d'être efficace dans ces 2 groupes entre le 9ème et le 16ème jour après la dose. Dans l'expérience 2, on a testé une administration double versus triple de LiCl (4g et 6 g) à des intervalles de 3 jours. On a trouvé que la plus haute dose de LiCl était mortelle chez 7/10 agneaux. L'administration double de 4 g LiCl s'est avérée aussi efficace que l'administration triple : l'aversion à la vesce était efficace jusqu'au 19ème jour après la première dose.

Mots-clés : Aversion alimentaire conditionnée, ovins, ingestion d'aliment, *Ferula communis*.

Introduction

The circum-Mediterranean perennial *Ferula communis* (giant fennel) is known to contain anticoagulant constituents in healthy, fresh plant material (Egyed *et al.*, 1985). Mortality can affect 5% of the flock. Most casualties are ewe-lambs at the onset of the grazing season within 30 days after sheep are turned from housing to grazing (Egber, unpublished). It seems that no post-ingestive pain is felt when sheep feed on giant fennel (Egyed *et al.*, 1985). In addition, giant fennel is abundant and palatable: these are favourable

conditions for the implementation of conditioned feed aversion (CFA) e.g. artificial build-up of post-ingestive pain for educational purposes (Ralphs, 1992). LiCl has been frequently chosen as malaise inducing agent in the CFA procedure, due to relative safety and taste analogy with NaCl (Burritt and Provenza, 1990; Ralphs, 1992).

The aim of the project is to decrease significantly the intake of giant fennel during 30 days, using CFA, because it does not represent a danger when available biomass on pasture is high, e.g. 30 days after sheep are first turned to pasture. As a first stage, we tested the feasibility of CFA to vetch hay, which is very palatable to lambs.

Material and methods

The experiments were carried out in Kibbutz Harel, in the Judean Hills.

Experiment 1

Twenty German Landschaff Merino ewe-lambs aged 40 days and weighing 16 kg on average were housed in individual cages on dust floor. They were daily fed a basal diet comprising 300 g of chopped oats hay and 300 g of a commercial concentrate (18% Crude Protein; Ambar, Hadera, Israel) fed in 2 troughs. The trough used for hay was divided in 2 parts by a plastic divider and the hay ration was laid in either side randomly, in order to prevent association between oats hay and location in the trough. Fresh water was available *ad lib.* After 14 day adaptation the lambs were provided with 300 g of chopped vetch hay in addition to the basal diet and immediately administered one of four treatments, using a de-worming drug pistol: 4 g NaCl (Control, C), 2 g LiCl (Li2), 4 g LiCl (Li4) or 6 g LiCl (Li6) in 18% aqueous (W/V) solution. The effectiveness of CFA to vetch was tested on days 3, 6, 9 and 16 after the CFA procedure, when 300 g of vetch hay were distributed in addition to the basal diet. Feed residuals were daily weighed, dried at 60°C for 3 days and analysed for NDF, ADF and CP according to AOAC (1984). Two criteria were retained to evaluate CFA: 1) if intake of vetch hay (% of offer) did not differ significantly from nil, CFA was considered totally successful; 2) if the intake of vetch hay in Li-treated lambs was significantly different from nil but differed from the intake in control lambs, CFA was considered partially successful.

Experiment 2

Twenty ewe-lambs weighing 15 kg on average were used in a bi-factorial trial, with LiCl dose (Li4 vs. Li6) and the number of times lambs were dosed (2 or 3, termed D2 and D3), resulting in 4 groups Li4D2, Li4D3, Li6D2 and Li6D3. The pre-experimental adaptation period lasted 4 days. Doses were administered on days 0 and 3 (D2) or 0, 3 and 6 (D3). Vetch hay was offered on days 0, 3, 6, 9, 16, 25 and 31 after the first dosing.

Statistics

The effects of LiCl doses on the percentage of vetch hay consumed were evaluated by ANOVA using a repeated-measures procedure with lamb within treatment (experiment 1) or lamb within treatment x no. doses (experiment 2) as the term of error (SAS, 1985).

Results and discussion

Vetch hay was spontaneously preferred to oats hay (Fig. 1a). Overall, the amplitude of aversion was related positively with the LiCl dose. No aversion to vetch was noted in lambs dosed with 2 g LiCl (Fig. 1b) which consumed as significant amounts of vetch as the controls throughout the experiment (Table 1). Absolute aversion to vetch lasted less than 6 and 9 days for Li4 and Li6, respectively (Figs 1c and d). They consumed less vetch hay until day 3 and day 9 post-dosing, compared to the controls (Table

1). Aversion to vetch ceased to be effective in Li4 between day 3 to day 6, and in Li6 - between day 9 and day 16 post-dosing. No effect of LiCl on the selection of feed components by lambs was noted (not shown), but a mild decrease in concentrate intake was noted in Li6 lambs following LiCl treatment (Fig. 1d). Although the CFA strategy was shown to be potentially valuable to affect dietary choice in Merino weaned lambs, the target of 30 day delay in vetch hay consumption was not achieved, therefore experiment 2 was justified.

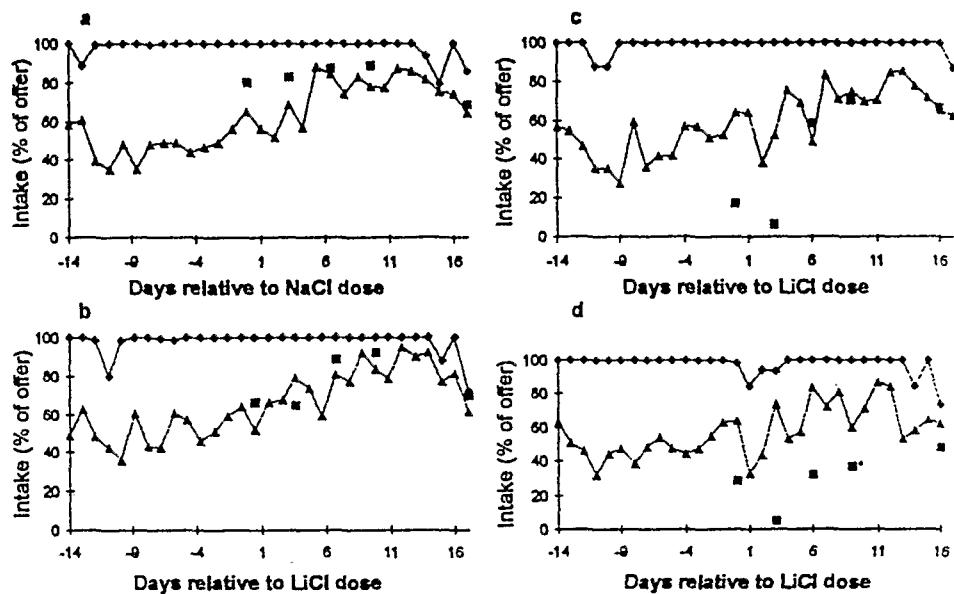


Fig. 1. Intake (% of offer) of concentrates (♦), oats hay (Δ) and vetch hay (■) after a single dose of NaCl (4g, a) or LiCl(2g, 4g, 6g; b, c, d, respectively) following first distribution of vetch hay (averages of five lambs per treatment).

Table 1. Significance of differences in vetch hay intake between lambs following a single dose at first distribution of vetch hay. Doses were 0g (Li0), 2g (Li2), 4g (Li4) or 6g (Li6)

	Li4					Li6				
	Day 0	Day 3	Day 6	Day 9	Day 16	Day 0	Day 3	Day 6	Day 9	Day 16
Li0	0.04	0.01	n.s.	n.s.	n.s.	0.10	0.01	0.08	0.02	n.s.
Li2	0.11	0.06	n.s.	n.s.	n.s.	n.s.	0.07	0.08	0.05	n.s.

In experiment 2, the 6 g dose of LiCl was found to be lethal in 7/10 lambs. Affected lambs stopped eating and looked depressed. It is possible that 4 days adaptation was too short a period to confer the status of "learned safety" to oats hay and concentrate, and CFA was directed against them too. Mortality started on day 2 after dosing. Therefore, the results presented here (Fig. 2) concern lambs given doses of 4 g LiCl only (Li4D2 and Li4D3). Double administration of 4 g LiCl was found as effective as triple administration: aversion from vetch was effective until day 19 after 1st dosing. Intake of concentrate was mildly depressed for 3 days in lambs in Li4D2 group and strongly depressed for approx. 10 days in Li4D3.

The results of this study confirm that the feeding behaviour of ewe-lambs can be manipulated using CFA, as found before in heifers (Ralphs, 1992) and sheep (Burritt and Provenza, 1990). A dose of 6 g LiCl, i.e., 400 mg kg^{-1} BW was found to be lethal, whereas no problems were encountered when lambs were treated with 266 mg kg^{-1} BW. A practical problem for implementation of CFA using LiCl in lambs would be the narrow range between effective and lethal doses. Our data confirm that in order to keep

aversion effective, it is necessary to dose animals several times as found before in heifers (Ralphs, 1992) and in goat kids (A. Nastis, pers. comm.). However, aversion to giant fennel, which will be studied in phase 2 of this project, could prove easier, because it is less palatable than vetch hay.

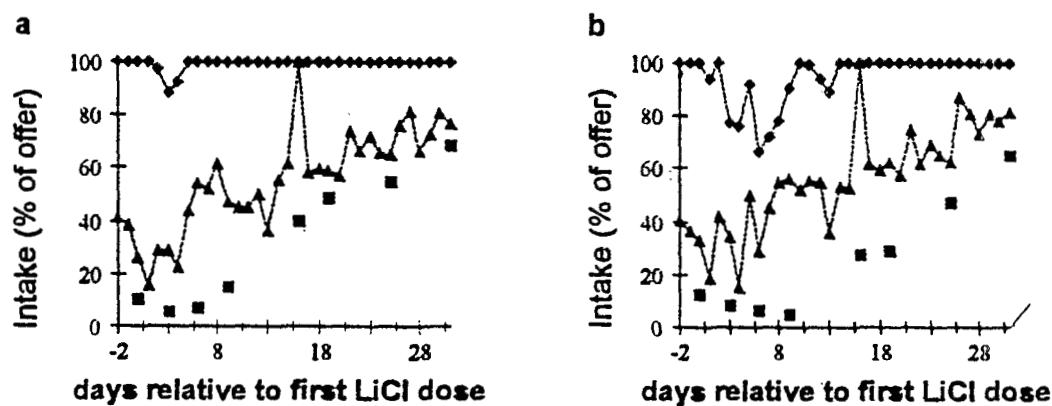


Fig. 2. Intake (% of offer) of concentrates (♦), oats hay (Δ) and vetch hay (■) in ewe-lambs dosed two times (days 0 and 3, a) or three times (days 0, 3, 6; b) with 4 g LiCl: averages of five lambs.

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