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Abnormal reproductive observations for beef cows on arid rangelands, associated with suspected increase in dietary phytoestrogens

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Abstract

Abnormal vulvar enlargement was observed one to eight weeks prior to calving for 72% (24/33) of a group of young beef cows on a research station in the Alice Springs district; those cows had a higher proportion of perinatal calf loss (6/24) compared to that of the other nine cows (1/9). Given circumstantial evidence about the seasonal arid rangeland diet, it is hypothesised that dietary phytoestrogens had a biological impact on the pre-calving hormonal cascade of the cows, and this was associated with untimely change in the external reproductive tract, plus increasing risk of perinatal calf loss. Analyses of rangeland feed and epidemiological data are required to test this hypothesis.

Introduction

Old Man Plains Research Station (OMP), 25 km south-west of Alice Springs, provides a venue to investigate aspects of extensive-grazing that are otherwise difficult to observe. This case study on OMP describes potential interactions between an arid rangeland diet and cattle reproduction.

Study activity

In 2014, calving of control-mated, young beef cows (2 to 4 years old) on OMP was recorded during checks (three to five times per week) in two paddocks (paddock A: low open mixed species woodland and tall open *Acacia* shrubland with grassland understorey; paddock B: tall open/ sparse *Acacia* shrubland with grassland understorey). Up to eight weeks prior to calving, some cows had abnormal vulvar enlargement, which with increasing periods prior to calving was associated with a higher proportion of cows with perinatal calf loss. Summary data are provided in Table 1 for 33 calving cows with vulvar change that persisted for normal to prolonged periods prior to calving.

New leafy shoots and flowers or seed-heads were noted concurrently on pasture grasses (e.g. *Cenchrus ciliaris*) and 'topfeed', such as the *Acacia* spp. shrubs that cows were selectively browsing in both paddocks. Identified plant fragments from the rumens of three heifer-cohorts indicated a high percentage of grasses and at least nine different seeding plants. All heifer-cohorts had consumed seeds of *Abutilon* sp., *Sida* sp. and *Enneapogon avenaceus*, as well as leaves of *Acacia* spp. shrubs (Table 2). This confirmed that the seasonal cattle diet incorporated a 'fruiting' stage of growth, plus plants of the Gramineae and Fabaceae (Leguminosae) families.

Discussion

Plants in the Gramineae and Fabaceae families can produce oestrogen-like substances such as phytoestrogens (Hughes Jr. 1988) in leaves, fruits or roots (Kelly 2003). For example, phytoestrogens have been demonstrated in *Acacia* spp. on rangelands of Texas, USA (Forbes and Clement 2010).

Dietary phytoestrogens mimic or modulate the effect of endogenous oestrogens and thereby produce physical and fertility effects in humans and animals (Burton and Wells 2002; Wocławek-Potocka et al. 2013). In ruminants, this includes effects on the ovaries and uterus (Shore et al. 1998; Burton and Wells 2002; Młynarczyk et al. 2013; Wocławek-Potocka et al. 2013), reproductive tract histology (Adams 1996), and survival of the foetus or neonate (Obst and Seamark 1975; Shore et al. 1998). Specific effects on oestrus (Adams 1995; Shore et al. 2010), conception and lactation (Moule 1962; Adams 1995) have been reported in cattle.

Table 1. Observed number of calving cows and associated number of perinatal calf deaths, categorised by period between first vulvar change and calving.

	Period between first vulvar change and calving*			Paddock total
	normal 1 to 6 days	extended 7 to 13 days	prolonged 14 + days	
Paddock A				
Calving cows	3	5	5	13
(Calf deaths)	(1)	(1)	(3)	(5)
Paddock B				
Calving cows	6	8	6	20
(Calf deaths)	(0)	(1)	(1)	(2)
Period total				
Calving cows	9	13	11	33
(Calf deaths)	(1)	(2)	(4)	(7)

*First vulvar change was observed between 3rd Sept. and 10th Oct. 2014 (37 days).

Normal development of pregnancy requires interacting hormones that form a cascade for calving (Shenavai et al. 2012). The vulva may start relaxing and stretching six weeks prior to normal calving; extreme vulvar enlargement with relaxation of the pelvic ligaments is normally noted within the last six days of pregnancy (Cooke et al. 2007).

This case study provides circumstantial evidence about dietary phytoestrogens and adverse biological effects on the hormonal cascade required for calving. Detection of adverse effects in cattle is difficult if they mimic reproductive tract changes of normal oestrus, pregnancy or calving. Adverse effects can also be subclinical and confounded by the presence of plant factors (Adams 1995, 1996; Eriksen 2006) or animal factors (Lindner 1967; Cox and Braden 1974; Adams 1995, 1996; Eriksen 2006; Wocławek-Potocka et al. 2013) that vary the bioactivity of phytoestrogens. Detection thus requires longitudinal and epidemiological studies (Adams 1995; Burton and Wells 2002), including measures of phytoestrogens in the feed and records of time-related observations.

Conclusions

Based on this case study, it is hypothesised that after phytoestrogens were consumed by young beef cows on OMP, a biological impact on the pre-calving hormonal cascade caused untimely change in the external reproductive tract and increased the risk of perinatal calf loss. Testing of this hypothesis requires analyses of cattle data and feed, in order to examine associations between a seasonal arid rangeland diet, dietary phytoestrogens and abnormal reproductive observations for extensively-grazing cows.

Table 2. Plants identified from fragments in rumens of three heifer-cohorts.

Plant Identified		Plant Fragments	
botanical name	common name	(number of heifer-cohorts)	Pods, seeds or flowers
grass			
<i>Cenchrus ciliaris</i>	Buffel grass	(3)	+
<i>Eragrostis eriopoda</i>	Woollybutt grass	(1)	
<i>Enneapogon avenaceus</i>	Native Oat grass	(3)	+
herb			
<i>Abutilon otocarpum</i>	Abutilon	(3)	+
<i>Calandrinia polyandra</i>	Parkeelya	(1)	+
<i>Eriochiton scleranthoides</i>	Sclerolaena	(1)	+
<i>Maireana scleroptera</i>	Bluebush	(1)	+
<i>Sida filiformis</i>	Fine Sida	(3)	+
tree/ shrub			
Fabaceae (family)		(1)	+
<i>Acacia aneura</i>	Mulga	(1)	
<i>Acacia ligulata</i>	Umbrella bush	(1)	
<i>Acacia victoriae</i>	Prickley Acacia	(2)	
<i>Atriplex</i> sp.	(saltbush)	(2)	+
<i>Eucalyptus socialis</i>	Mallee	(1)	
<i>Senna</i> sp.	(wattles)	(1)	+

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