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BRIEF COMMUNICATION: Effect of gender and prior exposure on the intake and preference of sheep for plantain post-weaning

S.J. PAIN*, P.R. KENYON, S.T. MORRIS and P.D. KEMP

Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11-222,
Palmerston North 4442, New Zealand

*Corresponding author: s.j.pain@massey.ac.nz

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INTRODUCTION

Animals are exposed to a sensory learning environment both pre- and post-birth birth (Nicolaïdis, 2008). Numerous experiments with rats (Smotherman, 1982), chickens (Porter & Picard, 1998; Sneddon *et al.*, 1998) and sheep (Nolte *et al.*, 1992; Schaal *et al.*, 1995; Simitzis *et al.*, 2008) have demonstrated prenatal exposure to chemosensory stimuli via maternal consumption. This early *in utero* flavour exposure primes the chemosensory system of the neonate, promoting long-term flavour memories that can influence postnatal feeding behaviour (Simitzis *et al.*, 2008). However, data regarding this phenomenon in lambs using fresh New Zealand herbages is limited. Increased knowledge of prenatal flavour exposure may be a beneficial method of modifying the feeding preferences of sheep. When fed to sheep, despite having an intake rate similar to that of ryegrass pasture, plantain (*Plantago lanceolata*) has been reported as having a low feed preference (Pain *et al.*, 2010). Sheep with pre-natally acquired sensory experiences may have a quicker transition to herbage types, such as plantain, resulting in an increased voluntary intake, and potentially increased subsequent performance. Pre- or post-natal exposure to novel forages may be a valuable tool for maximising performance in growing lambs.

This study evaluated the effect of gender, and pre-natal (*in utero*) and post-natal (suckling period) flavour exposure of plantain on the post-weaning intake rate and short-term feed preferences of male and female lambs for plantain and ryegrass/white clover pasture in summer during February.

MATERIALS AND METHODS

Lambs from three different “flavour exposure” treatments were generated: RG/RG with no exposure to plantain *in utero* or during the suckling period when the ewe and lamb were grazing ryegrass/white clover pasture only; PI/RG with the ewe being offered plantain during late gestation and the lamb receiving *in utero* exposure to plantain, followed by the ewe and lamb grazing ryegrass/white clover pasture during lactation, and; PI/PI with the ewe being offered exposure to

plantain during *in utero* late-gestation and lactation. Plantain exposure was provided to PI/RG lambs by grazing their dams on plantain for four weeks late gestation and then removing the dams one week prior to lambing to graze on ryegrass/white clover pasture until weaning. Plantain exposure was provided to PI/PI lambs by grazing their dams on plantain only pasture from late gestation for five weeks prior to lambing until weaning. Whilst with their dam, the lambs had access to the forage their dam was grazing. After weaning, lambs were managed as one group and grazed on ryegrass/white clover pasture.

At five months of age, 56 mixed sex lambs (RG/RG = 19, PI/RG = 18 and PI/PI = 19) were placed into indoor pens for intake rate and preference tests. Lambs were offered a maintenance diet of lucerne chaff (0.65 kg) and sheep nuts (0.15 kg) whilst indoors and were given a 10 day adaptation period after which 26 lambs with a mean live weight \pm standard deviation of 41.5 ± 0.82 kg (RG/RG = 5 ram and 4 ewe lambs, PI/RG = 5 ram and 3 ewe lambs, and PI/PI = 4 ram and 5 ewe lambs) were selected and used to determine plantain and ryegrass/white clover pasture intake rate (g/minute) and their relative preference of plantain when offered simultaneously with a ryegrass/white clover pasture. The 26 lambs selected were those that had best adapted to the indoor facility and that were consistently eating a sufficient amount of the maintenance diet. Mean lamb live weight did not differ ($P > 0.05$) between groups. Both forages were fresh cut and fed daily.

To determine short-term feed preference each lamb was offered plantain and ryegrass/white clover pasture simultaneously as 200 g (fresh weight) of each forage in two adjacent feed bins, for a period of five minutes. The relative intake of each forage was determined by weighing the refusal. Preference was calculated as the intake of one feed as a percentage of the combined intake of the two feeds on offer. Preference tests were repeated three times for each animal with a minimum of 30 minutes between tests. Intake rate (g/minute) of both plantain and ryegrass/white clover pasture when offered individually were determined for each lamb in triplicate. Each lamb was offered 200 g of forage,

split over two adjacent feed bins, for a period of five minutes. Intake rate for each forage was calculated as the amount of herbage (grams) consumed per minute.

This study was conducted with the approval of the Massey University's Animal Ethics Committee. Lamb intake rate and preference were analysed using the MIXED procedure of SAS® 9.2 (SAS Institute Inc., Cary, NC, USA). Forage type, flavour exposure treatment and gender were fitted as fixed effects with animal and date fitted as random effects. Reported values are least square means \pm the standard error.

RESULTS AND DISCUSSION

Mean intake rate of plantain and ryegrass/white clover pasture was similar ($P > 0.05$; Table 1), however intake rate tended ($P = 0.06$; Table 1) to be greater for PI/PI lambs compared to RG/RG lambs. Mean intake rate of PI/RG lambs did not differ ($P > 0.05$; Table 1) from either PI/PI or RG/RG lambs. Additionally, intake rate of ram lambs was greater ($P < 0.05$; Table 1) than that of ewe lambs. There were no two-way or three-way interactions between flavour exposure treatment, forage type or gender ($P > 0.05$). The similar mean intake rate of plantain and ryegrass/white clover pasture observed in this study are comparable to values also measured in summer and reported by Pain *et al.* (2010) for plantain and ryegrass/white clover pasture. It is interesting that prior flavour exposure to plantain appears to have influenced lamb intake rate, with PI/PI lambs having a greater mean intake rate than RG/RG lambs, suggesting a possible fetal programming effect associated with feed intake regulation. Nutrient restriction of the dam during gestation has been shown to result in an adaptive response in the offspring to have increased intake/appetite (Taylor & Poston, 2007), however there is no indication in this study that the PI/PI lambs were nutrient restricted *in utero*.

There was no effect of flavour exposure treatment on lamb preference for plantain ($P > 0.05$; Table 2). There was also no interaction between flavour exposure treatment and gender for preference ($P > 0.05$). However, gender tended to effect plantain preference ($P = 0.07$; Table 2), with ewe lambs generally showing a greater preference for plantain than ram lambs. Whilst gender sensory differences have been demonstrated in several human studies (Tilgner & Barylko-Pilielna, 1959; Gilbert & Wysocki, 1987), and males and female pigs have been shown to select feeds differently according to nutrient content

TABLE 1: Least square mean \pm standard error of intake rate (g/minute) for lambs fed plantain and ryegrass; for lambs from three different flavour exposure treatments where the ewe was offered ryegrass/white clover during late gestation and the ewe and lamb were offered ryegrass /white clover during lactation (RG/RG), plantain during late gestation and ryegrass/white clover during lactation (PI/RG), and plantain during late gestation and during lactation (PI/PI); and for ram and ewe lambs.

Effect	Average intake rate (g/min)
Forage type	
Plantain	21.5 \pm 1.6
Ryegrass/white clover	23.2 \pm 1.6
Exposure treatment	
RG/RG lambs	20.0 \pm 1.3*
PI/RG lambs	22.2 \pm 1.9**†
PI/PI lambs	24.9 \pm 1.8†
Gender	
Ram lambs	24.6 \pm 1.6 ^b
Ewe lambs	20.1 \pm 1.7 ^a

^{ab}Different superscripts within category and column indicate values that differ significantly differ ($P < 0.05$)

^{**†}Different superscripts within category and column indicate values that differ significantly ($P < 0.10$)

TABLE 2: Least square mean \pm standard error of plantain and ryegrass/white clover pasture preference (%) values for lambs from three different flavour exposure treatments where the ewe was offered ryegrass/white clover during late gestation and the ewe and lamb were offered ryegrass /white clover during lactation (RG/RG), plantain during late gestation and ryegrass/white clover during lactation (PI/RG), and plantain during late gestation and during lactation (PI/PI); and for ram and ewe lambs.

Effect	Preference (%)	
	Plantain offered versus Ryegrass/white clover	Ryegrass/white clover offered versus Plantain
Forage type	61.9 \pm 2.5	42.2 \pm 2.8
Exposure treatment		
RG/RG lambs	67.1 \pm 9.0	34.5 \pm 9.1
PI/RG lambs	62.4 \pm 9.3	49.8 \pm 9.2
PI/PI lambs	56.4 \pm 9.2	45.1 \pm 8.5
Gender		
Ram lambs	56.0 \pm 8.5*	41.9 \pm 7.4
Ewe lambs	67.9 \pm 8.6†	44.4 \pm 8.2

*†Different superscripts within category and column indicate values that differ significantly ($P < 0.10$)

(Forbes & Kyriazakis, 1995), the findings in the present study warrant further investigation. Schaal and Orgeur (1992) and Schaal *et al.* (1995) reported that the ovine perinatal is capable of nasal chemoreception and can retain postnatal memories of prenatally experienced odorants for some time after birth which does influences their food searching behaviour. However they also state that in order for transnatal chemosensory learning to occur there must be efficient odorivector compounds in the fetal environment. The present study did not investigate if plantain volatiles were present in the amniotic fluid or in the milk of those dams grazed on plantain during late gestation and/or lactation. It is possible that the lack of response seen in this study may be due to an inability to provide sufficient *in utero* and/or suckling flavour exposure to the lambs.

The level of food intake is one of the most important factors determining animal performance (Illius & Jessop, 1996), and appears to depend upon the ease with which a feed can be eaten, its accessibility, and its relative acceptability or preference (Kennedy & Black, 1984). Feed preferences are known to be a function of the taste, odour and texture (Arnold, 1980), which can be modified by experience. Pre-natally imprinted diet preferences are useful to the future offspring as by taking advantage of their mother's experience, they gain a larger spectrum of food choices, which may result in easier feed neophilia and less neophobia (Simitzis *et al.*, 2008). Whilst this study showed no effect of prior (prenatal or suckling) flavour exposure on post-weaning feed preferences for plantain, it did show an effect on the lamb's rate of short-term voluntary feed intake which may ultimately influence their subsequent growth performance.

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