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Effect of maternal protein supply prepartum on the gastrointestinal nematode infection in the ewe and their progeny



Key external stakeholders:

Sheep producers, sheep industry, parasitologists, nutritionists.

Practical implications for stakeholders:

Ewes experience a temporary decline in resistance to gastrointestinal nematodes (GIN) during the periparturient period, characterised by a rise in faecal egg count (FEC) that represents a major source of pasture contamination for naïve progeny. Previous studies using experimental nematode parasitic challenge have suggested that the GIN resistance status of the ewe is influenced by differences between the requirement for, and supply of, metabolisable protein (MP); in particular, digestible undegradable protein (DUP).

Results of this study indicate that changing the level of DUP supplementation (representative of the range offered on many commercial sheep units in Ireland) of housed ewes, which have a resident natural infection during the last 6 weeks of pregnancy, does not influence the periparturient rise in FEC nor the capacity of the progeny to mount an immune response to GIN challenge as shown by results on FEC. Worm burden and growth performance from birth to slaughter, whilst grazing naturally infected pastures, was not affected. Likewise, while increasing concentrate feed level during late pregnancy essentially eliminated the loss of ewe live weight over this period; there was no effect on FEC.

Results from this study indicate there is no advantage from supplementation with DUP, or increasing MP supply, in late pregnancy as a means of controlling the peri-parturient rise (PPR) when the infection is already established, as commonly applies under practical farming conditions. This highlights the need for caution when extrapolating effects obtained under experimental conditions to the conditions that obtain in normal husbandry/management practices.

Main results:

- The level of DUP supplementation during the last 6 weeks of pregnancy did not affect FEC, BW or BCS of naturally infected ewes.
- The level of DUP supplementation during the last 6 weeks of pregnancy did not affect lambs susceptibility to gastrointestinal infection

Opportunity / Benefit:

The need for caution when extrapolating effects obtained under experimental conditions to the conditions that obtain in normal husbandry/management practice has been highlighted. Altering the level of DUP in the diet of ewes in late pregnancy, representative of the range in most farms in Ireland had no effect on FEC in naturally infected ewes or the susceptibility of their progeny to gastrointestinal infection. Therefore, altering the type of protein offered to ewes to pregnant ewes does not provide a control measure for subsequent gastrointestinal parasitic infection.

Collaborating Institutions:

UCD

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1. Project background:

Gastrointestinal nematodes (GIN) are a major cause of disease in small ruminant systems. In late pregnancy and early lactation, the normal immune mechanisms that regulate nematode populations, are relaxed and ewes display a transitory rise in worm egg count known as the periparturient rise (PPR). The periparturient ewe may be regarded as the major contributor to pasture contamination with gastrointestinal nematodes and the importance of this rise in faecal egg count (FEC) is that it coincides with the availability of susceptible hosts i.e. young lambs, thus enhancing parasite survival. While traditional husbandry practices have relied on anthelmintics in combination with grazing management to control gastrointestinal nematode infection in sheep, the evolution of anthelmintic resistance in nematode populations has driven the quest to develop more sustainable parasite control strategies such as those that exploit the hosts immune response to infection be it through breeding or fortifying the hosts immune capability via nutritional intervention.

Previous studies have suggested that the GIN resistance status of the ewe maybe influenced by differences between the requirement for, and supply of, metabolisable protein (MP); in particular, digestible undegradable protein (DUP). Moreover, there are increasing reports suggesting that maternal nutrition during pregnancy is a major environmental influence on foetal development with consequent effects on postnatal performance.

In the majority of the studies examining the effects of protein supplementation on the PPR of ewes, the experimental design involved ewes having been treated with anthelmintics to remove their natural infection prior to receiving a trickle infection with GIN larvae during the experimental period. However, there is a paucity of data on the effects of protein supplementation on the PPR of ewes that have a naturally acquired GIN infection and are housed and offered forage-based diets during late pregnancy, which is common practice in Ireland. Thus, the objectives of the project were to evaluate the effect of the level of digestible undegradable protein (DUP) supplied during the last 6 weeks of pregnancy on (a) periparturient faecal egg count and on the performance of ewes with a naturally acquired GIN infection and (b) the performance and immune response of their offspring to GIN infection.

2. Questions addressed by the project:

- Can the amount of digestible undegradable protein offered to ewes in late pregnancy affect the periparturient change in resistance to gastrointestinal nematodes?
- Can the amount of digestible undegradable protein offered to ewes during late pregnancy affect the performance and immune response of their offspring to gastrointestinal nematodes?

3. The experimental studies:

Eighty-five Belclare and Belclare x Scottish Blackface twin/triplet-bearing ewes were randomly allocated to 1 of 4 dietary groups representing the combination of 2 concentrate DUP concentrations (29 and 94 g/kg DM) with 2 levels of concentrate offered during the final 6 weeks of pregnancy (18 and 30 kg for ewes with twins; 24 and 35 kg for ewes with triplets). All ewes were housed during the pre-partum feeding period and offered grass silage *ad libitum*; food intake was recorded daily. The intake of DUP varied from 26 to 72 g/d among treatments and was reflected in variation of 0.76 to 1.20 in metabolisable protein supply as a proportion of requirements.

After lambing, ewes and lambs grazed on permanent sheep pasture, without concentrate supplementation, managed as one flock in a rotational grazing system involving 5 paddocks until weaning (14 weeks post lambing). Ewes with triplets had one lamb removed at birth so that all ewes nursed 2 lambs when put to pasture. Paddocks were grazed to achieve target sward heights. The number of infective third-stage (L3) larvae on herbage was determined, just prior to grazing of each paddock based on 2 samples of herbage from each paddock. All lambs were dosed with a levamisole anthelmintic at 5 weeks of age to ameliorate negative consequences of *N. battus* challenge. They were treated, on 2 further occasions (weaning and at 21 weeks of age) with an oral ivermectin; these treatments followed extended periods of nematode challenge (mainly from *T. circumcincta* and *Trich. spp.*) in order to maximise the opportunity for any dietary-treatment

effects on immune competence to be revealed. All anthelmintic treatments were administered in accordance with the manufacturer's instructions.

Faecal egg count (FEC) and serum concentrations of pepsinogen were assessed for all ewes at various time points from week 6 pre-lambing up to week 10 post-lambing. Animal performance [body weight (BW) and body condition score (BCS)] was recorded for all ewes.

Faecal egg count and concentration of serum IgA and IgE specific for *Teladorsagia circumcincta* were assessed for all lambs at various time points between 10 weeks of age and slaughter. Animal performance (live weight, live-weight gain, carcass weight) was recorded for all lambs. Worm burden at slaughter was determined for a sample of 12 lambs from each treatment.

4. Main results:

Ewes: Faecal egg count in ewes clearly increased during the last 3 weeks prior to parturition and remains elevated up to 6 weeks post-partum and the temporal changes in serum concentrations of pepsinogen were consistent with this breakdown in immunity. The effect of week (relative to lambing date) on FEC was highly significant ($P < 0.001$). However, diet did not influence FEC ($P > 0.05$) at any stage either pre- or post-partum. Blood concentration of pepsinogen also varied with time but was not influenced by dietary treatment ($P > 0.05$). The changes in BW and BCS from 6 weeks before lambing to weaning were not affected by the concentration of DUP in the supplement but ewes on treatments involving the higher level of supplementation lost less BW and BCS ($P < 0.001$). The results of this study indicate that the level of DUP supplementation during the last 6 weeks of pregnancy does not affect FEC, BW or BCS of housed ewes with a naturally acquired GIN infection.

Lambs: Faecal egg count in lambs demonstrated significant exposure to GIN when grazing.. *Nematodirus* spp. FEC, 'other strongyles' FEC, and concentrations of serum IgA and IgE specific for *T. circumcincta* were unaffected either by the concentration of DUP in the concentrate or by the level of concentrate offered to ewes in late pregnancy ($P > 0.1$). Likewise, the dietary regime of the dams had no effect on lamb performance ($P > 0.1$). It is concluded that increasing the DUP intake of ewes in late pregnancy had no effect on the immune response of their offspring to gastro-intestinal nematode infection acquired through grazing naturally infected pasture.

5. Opportunity/Benefit:

These studies have highlighted the need for caution when extrapolating effects obtained under experimental conditions to the conditions that obtain in normal husbandry/management practice. There was no evidence that increasing DUP intake in pregnant naturally infected ewes helped to control GIN in them or their progeny.

6. Dissemination:

Presented at the Annual Agricultural Research Forum Conference 2015
Presented at protein workshop in SRUC 2016

Main publications:

Sebastiano R.S., Sweeney T., Good B., Hanrahan J.P., and Keady T.W.J (2017) 'Can the amount of digestible undegraded protein offered to ewes during late pregnancy affect the performance and immune response of their offspring to gastrointestinal nematodes?' *Veterinary Parasitology* 235; 8–16.

Sebastiano R.S., Sweeney T., Keady T.W.J., Hanrahan J.P., and Good B., (2017) 'Can the amount of digestible undegraded protein offered to ewes in late pregnancy affect the periparturient change in resistance to gastrointestinal nematodes?' *Veterinary Parasitology* in press.

7. Compiled by: Barbara Good and Tim Keady