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Building a healthier Irish dairy herd through improved calf health

Key external stakeholders:
Dairy farmers, vets, replacement heifer rearers, animal nutrition companies and consultants

Practical implications for stakeholders:
Healthy well-grown replacement heifers are essential to ensure the viability of any dairy enterprise. A calf depends entirely on colostrum to develop its immune system. Without adequate immunological protection, the newborn calf is more vulnerable to infection, more likely to develop disease and die in the pre-weaning and post-weaning period, have a slower growth rate and even reduced milk production during the first and second lactation. This project investigated a number of colostrum management practices which can be implemented by stakeholders to promote calf health and reduce incidences of calf mortality and morbidity on Irish dairy farms.

Main results:

- In general the colostrum quality (112 g/l IgG) of cows from well-managed moderate yielding Irish dairy herds of mixed breed is high (50 g/l current threshold which defines high and poor quality colostrum). Older parity cows, cows that were milked earlier post-calving, cows that produced a smaller quantity of colostrum and cows that calved earlier in spring or in autumn produced colostrum with higher IgG concentration. Reducing the time interval between calving and collection of colostrum is the most practical means by which the farmer can maximise colostral IgG concentration.
- Calves fed 8.5% of birth bodyweight in colostrum within 2 hours of birth achieved a greater concentration of IgG in serum in the first 3 days of life than calves fed 7 or 10% of birth bodyweight. Feeding calves transition milk subsequently reduced their odds of being assigned a worse eye/ear and nasal score.
- Over-supplementation of iodine in the precalving period does not affect the passive transfer of immunity to calves, however, this is not an encouragement to feed large quantities of iodine. Supplementation of the prepartum dairy cow with iodine above the level necessary to meet the minimum requirements established by the NRC was unnecessary to ensure appropriate iodine levels in calves at birth.
- Feeding calves 15% instead of 10% of their birth bodyweight in milk resulted in heavier calves at the beginning and end of the preweaning stage, tended to reduce the days taken to reach a target weaning weight, and had no unfavourable repercussions on calf health. Feeding calves this higher volume of milk once a day or in two equally divided meals from the third week of life did not affect calf performance or health.
- Colostrum with high levels of bacteria had a negative effect on IgG absorption in the pre-weaned dairy calf. Colostrum should be stored ≤4°C to minimise bacterial growth and improve subsequent passive transfer of immunoglobulins.

Opportunity / Benefit:

These results provide data on colostrum quality and management practices which can be implemented to improve calf health on Irish dairy farms. This will give dairy farmers, heifer rearers and animal nutrition companies and consultants the essential knowledge to ensure optimum growth and maximise calf health during the pre-weaning period.

Collaborating Institutions:

UCD
Animal Health Ireland

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1. Project background:

A policy Delphi survey of both farmers and experts carried out by Animal Health Ireland in 2009 identified calf health as a priority area that needs to be addressed. The All-island disease surveillance report revealed that over the past number of years almost two thirds of samples submitted from sick or dead calves showed failure of passive transfer or inadequate absorption of immunoglobulins (IgG).

2. Questions addressed by the project:

- Determination of the factors associated with colostral IgG concentration and colostral weight of the first milking post-calving in Irish dairy cows
- (1) compare serum IgG concentration, health parameters, and weight gain of calves fed different volumes of colostrum (7, 8.5, or 10% of birth BW) within 2 hours of birth, and (2) compare serum IgG concentration, health parameters, and weight gain in calves given no feeding of transition milk compared with calves given either 2 or 4 additional feedings of transition milk.
- Determine (1) the effects of offering varying levels of supplementary iodine to cows during the last 7 weeks of pregnancy on the serum IgG concentration, plasma inorganic iodine (PII) concentration, and health parameters of their calves; (2) the effects of timing of iodine supplementation of cows and heifers during the precalving period on the serum IgG concentration, PII concentration, and health parameters of their calves; and (3) whether any reduction in the serum IgG concentration of the calves was mediated through a preprogramming of the calf with an impaired absorptive ability or through an effect on the colostrum itself
- Determine the effect of feeding volume and frequency of feeding on the bodyweight and health of dairy heifer calves with access to pasture
- Investigate the effect of colostrum stored at varying temperatures to induce a difference in bacteria levels on the rate of passive transfer of IgG and average daily weight gain from birth to weaning of dairy heifer calves

3. The experimental studies:

Factors associated with the concentration of immunoglobulin G in the colostrum of dairy cows

Fresh colostrum samples were collected from 704 dairy cows of varying breed and parity from four Teagasc Moorepark research farms. Each cow was milked by machine at the next scheduled herd milking time following calving. Colostrum was collected in a steel churn, the weight was recorded and a sample of colostrum was obtained and frozen at -20^{o}C until analysis. The IgG concentration was determined using an ELISA method. Information recorded from the cows included time and date of birth, sex, weight and breed of the calf, whether the calf was born alive or stillborn, presentation of the calf, degree of calving difficulty, time interval from calving to subsequent milking, cow body weight measured up to 14 days post-calving and body condition score measured within 14 days of calving, length of dry period, cow EBI, breed fraction, and degree of heterosis and recombination. These factors were statistically analysed to determine which were associated with colostrum IgG concentration.

Effect of feeding colostrum at different volumes and subsequent number of transition milk feeds on the serum immunoglobulin G concentration and health status of dairy calves

Ninety-nine dairy calves were stratified based on breed, gender, and BW at birth and randomly assigned to one of three experimental treatment groups: fed either i) 7% (7C), ii) 8.5% (8.5C) or iii) 10% (10C) of their birth bodyweight in colostrum within two hours of birth. The colostrum fed was pooled colostrum obtained at the first milking post-calving from the freshly calved cows Concentration of IgG in the serum of calves was measured at 0, 24, 48, 72 and 642 hours of age by an ELISA method (Bovine IgG ELISA Kit Cat. No. 8010, Alpha Diagnostic International, San Antonio, TX, USA).

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Does iodine supplementation of the prepartum dairy cow diet affect serum immunoglobulin G concentration, iodine, and health status of the calf?
Calves were assigned to one of six treatment groups, based on the level of pre-partum I supplementation of their dam and the colostrum that they received. The treatments were: (1)HI I: born to dams supplemented at three times the current maximum permitted limit (15 mg/kg), fed colostrum HI I colostrum; (2) NO I: born to dams that received no I supplementation, fed NO I colostrum; (3) STD I: born to dams that received the current maximum permitted level of I (5 mg/kg), fed STD I colostrum; (4) HI I X: calves born to HI I dams, fed colostrum from NO I cows; (5) NO I X: calves born to NO I dams, fed HI I colostrum; (6) HI-NO I: calves born to dams that received the high level of I supplementation for the first half of the dry period and no I supplementation for the second half. Calves continued to receive milk from their respective treatments for the first 72 hours of life after which treatments were managed similarly. Individual animal health scores were assigned to calves on a twice weekly basis by one trained observer. Heifer calves were scored twice weekly from birth until weaning at approximately twelve weeks of age; scores were assigned to male calves from birth until they were sold between two and four weeks of age. Health scores were assigned using a calf health scoring system developed by the School of Veterinary Medicine, University of Wisconsin-Madison. Calves were scored on four different aspects of health. Each individual aspect received a score from zero to three; zero representing normal and three representing the most severely affected.

Effects of milk feeding volume and frequency on body weight and health of dairy heifer calves
Ninety-six dairy replacement heifer calves were randomly assigned to one of the following three treatments: i) offered milk at a rate of 8-10% of birth bodyweight (BW) once daily (10% OAD) ii) offered milk at a rate of 15% BW once daily (15% OAD) and iii) offered milk at a rate of 15% BW in two equal feeds until weaning (15% TAD). Within each treatment calves were sub-divided based on birth BW (heavy > 35kg and light ≤ 35 kg) to minimise differences in volumes offered. All heifers were weighed at birth and fed 7.5% of their BW in colostrum within the first hour. All calves were offered 2L twice daily for 4 days and subsequently fed twice daily according to their treatment until turnout at 3 weeks. The amount of concentrates fed to each group was recorded. Weekly weighing was carried out until all calves attained their target weaning BW (95kg HF, NRX and 80kg JEX). Once they achieved their target BW calves were removed from the group and gradually weaned during the subsequent week. In the fourth and eighth week following weaning, calf BW was measured to monitor any carry over effects.

Effect of bacteria level in colostrum on dairy heifer serum IgG concentration and pre-weaning growth rate
Colostrum was collected immediately post-partum from individual Holstein-Friesian (HF) cows, tested for IgG concentration using a colostrometer (to block for quality), and assigned to 1 of 5 treatments to create colostrum of varying bacteria levels: 1) pasteurised, 2) fed when freshly collected, 3) stored at 4°C for ≥48 hours (reflects fridge storage), 4) stored at 13°C ≥48 hours, and 5) stored at 22°C ≥48 hours. A sample of colostrum corresponding to each calf was stored for subsequent testing of IgG concentration using Radial Immunodiffusion (RID Triple J Farms, WA, USA) and TBC, using serial dilution. Seventy-five HF and HF×Jersey (JEX) heifer calves were removed from their dam and assigned to a treatment immediately post-partum at Teagasc Moorepark Research Farm, Co. Cork. All calves were fed 8.5% of their birth bodyweight in colostrum via stomach tube within 2 hours. Calf blood samples were collected at 0 (control) and 24 hours of age and analysed for IgG concentration via RID. Calves were weighed weekly and weaned at 90kg (HF) or 85kg (JEX).

4. Main results:

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5. Opportunity/Benefit:

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6. Dissemination:

The primary stakeholders for this research are Irish dairy farmers, vets, heifer rearers, animal nutrition companies and consultants. The results of this project have been disseminated through the popular press and at the Teagasc Moorepark open days, Animal Health Ireland open days as well as at scientific conferences and in scientific peer-reviewed publications.

Main publications:

Conneely, M., D. P. Berry, R. Sayers, J. P. Murphy, I. Lorenz, M. L. Doherty, and E. Kennedy. 2013. Factors associated with the concentration of immunoglobulin G in the colostrum of dairy cows. Animal. 11:1824-1832.

Conneely, M., D. P. Berry, R. Sayers, J. P. Murphy, M. L. Doherty, I. Lorenz, and E. Kennedy. 2014. Does iodine supplementation of the prepartum dairy cow diet affect serum immunoglobulin G concentration, iodine, and health status of the calf? Journal of Dairy Science. 97:5120-5130.

Conneely, M., D. P. Berry, J. P. Murphy, I. Lorenz, M. L. Doherty, and E. Kennedy. 2014. Effects of milk feeding volume and frequency on body weight and health of dairy heifer calves. Livestock Science. 161(0):90-94.

Popular publications:

Kennedy, E., Conneely, M. and Murphy, J.P. (2013). Rearing healthy calves. Todays Farm 24 (July/August) p.: 23 30225 C1

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