Animal & Grassland Research and Innovation Programme

Teagasc

# National Sheep Conferences 2018

**Tuesday, 30th January 2018**
**Loughrea Hotel and Spa, Loughrea, Co. Galway.**

**&**

**Thursday 1st February 2018 Nuremore Hotel, Carrickmacross, Co. Monaghan.**

Teagasc

Agriculture and Food Development Authority

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# National
# Sheep Conferences
# 2018

# Teagasc National Sheep Conference 2018

**Venue:** The Loughrea Hotel, Loughrea.

**Date:** Tuesday, 30th January 2018.

## Conference Outline

| | |
|---|---|
| 17:30 | **KT Sign-in.**<br>*Chairman: Pat Clarke, Regional Manager, Galway/Clare Advisory Region.* |
| 18.00 | **Conference Opening.**<br>*Professor Gerry Boyle, Director, Teagasc.* |
| 18:15 | **Why are you here today? Focus on Take-Home Messages.**<br>*Damien Costello, Teagasc, Athenry, Co. Galway.* |
| 18.25 | **Grass10: Can we achieve more from grazing systems in sheep production?**<br>*Philip Creighton, Teagasc, Athenry, Co. Galway.* |
| 18.55 | **Late pregnancy feeding: Achieving your goals and avoiding common pitfalls.**<br>*Tommy Boland, University College, Dublin, Belfield, Dublin 4.* |
| 19.25 | **Does leaving lambs entire affect their meat quality?**<br>*Michael G Diskin, Teagasc, Athenry, Co. Galway.* |
| 19:55 | **Beware – Don't get hit with a hidden disease! – the truth behind OPA, Johnes & CLA and how to protect your flock.**<br>*Fiona Lovatt, Flock Health Ltd, Egglesburn Farm, Eggleston, Barnard Castle, & University of Nottingham, Sutton Bonington, Leicestershire.* |
| 20:25 | **Close Conference.**<br>Frank Hynes, *Teagasc, Athenry, Co. Galway.* |
| 20:30 | Tea/Coffee, Sandwiches & finger food served. |

**Organising Committee:** Michael Diskin, Philip Creighton, Frank Hynes, Michael Gottstein, Fiona McGovern, Frank Campion & Ciaran Lynch.

# Teagasc National Sheep Conference 2018

**Venue:** Nuremore Hotel, Carrickmacross, Co. Monaghan

**Date:** Thursday, 1st February 2018 .

## Conference Outline

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| 17:30 | **KT Sign-in.**<br>*Chairman: Con Feighery, Regional Manager, Westmeath/Offaly/Cavan/Monaghan Advisory Region.* |
| 18.00 | **Conference Opening.**<br>*Dr Frank O'Mara, Director of Research, Teagasc.* |
| 18:15 | **Why are you here today? Focus on Take-Home Messages.**<br>*Conal Murnahan, Teagasc, Co. Monaghan .* |
| 18.25 | **Grass10: Can we achieve more from grazing systems in sheep production?**<br>*Philip Creighton, Teagasc, Athenry, Co. Galway* |
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| 20:30 | Tea/Coffee, Sandwiches & finger food served. |

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# Foreword

Sheep production is a significant contributor to the agricultural and national economy producing 67,000 tonnes of sheep meat valued at more than €320 million. Over the past number of years we have seen small but steady increases in sheep numbers. Currently, there are 36,313 flocks in Ireland, producing a high quality product of which about 85% is exported. In 2017 almost 2.94 million sheep were processed in Irish processing plants with 57,000 tonnes of sheep meat exported, valued at €274 million. This represents a 14% increase in volume exported and a 12% increase in the value of exports over 2016 exports. This is an excellent performance, notwithstanding weaker sterling and the pressure it is putting on Irish lamb on both the British and Continental Europe market. The welcome increase in output and value of output partially reflects the expansion in the size of the national flock and also the development of new export markets for Irish sheep meat. New markets, particularly in Canada and Switzerland, are welcome. These markets will become increasingly important in the context of Brexit.

Significant employment is provided in both the primary production and processing sectors. The improvement in lamb prices in recent years combined with the development of new export markets would all suggest that 2018 could be a good year for the sheep industry. However, there is no room for complacency. Brexit is creating currency and other uncertainties. About 25% of Irish lamb is sold into the UK market. Technical performance in terms of ewe productivity, grassland management, nutrition and flock health are all important drivers of profitability and must be the sustained focus of all sheep producers and particularly in times of uncertainty. This is the clear message from today's conference.

The Teagasc 2016 National Farm Survey results show an average gross margin of €595/ha for lowland mid-season lambing flocks. However, the top one third of flocks generated a gross margin of €1329/ha compared to €268 for the bottom one third of flocks. Due to higher weaning and stocking rates, output on the Top farms (€1,881/ha) was more than double the output of the Bottom farms (€780/ha) and total direct costs were only marginally higher (€552/ha vs €512/ha) despite the significantly higher output. Gross margin per hectare is more than five times higher on the Top farms compared to the Bottom. This indicates that there is significant scope to increase income by improving technical efficiency on many farms.

Over the years significant amounts of new information is presented at these sheep conferences and this year is no different. Continuous generation of new information is critically important and the incorporation and application of this information into on-farm production systems must be the on-going goal of sheep farmers. There are a number of important take home messages from each of the papers. Farmers should focus on implementing a number of these messages on their farms. This is now the 6th year of the Teagasc National Sheep Conferences and they play a very important role in technology transfer to the sheep industry. This booklet collates and summarises a significant body of knowledge on technical issues in sheep production and should prove an invaluable reference to sheep producers. I would like to thank all the speakers, the Teagasc Staff who assisted in with the organisation of the National Sheep Conferences and especially the organising committee without whose efforts we would not be here today – they are; Michael Diskin, Frank Hynes, Phil Creighton, Ciaran Lynch, Fiona McGovern, Frank Campion and Michael Gottstein. I also acknowledge the help and input of local Teagasc advisory staff.

**Director, Teagasc.**

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# Grass10: Can we achieve more from grazing systems in sheep production?

*Philip Creighton,*
*Teagasc, Animal and Grassland Research and Innovation Centre, Athenry, Co Galway*

**Take Home Messages**

- Great potential exists to increase the level of grass grown and utilised on Irish sheep farms.
- Through management and the adoption of technologies, improvements can be readily achieved on most farms.
- Profitable increases in lamb output are underpinned by increases in grass utilisation.
- Challenge is to strengthen our ability to convert this grass into a quality lamb product and turn that product into profit.

## Introduction

Grass-based livestock production systems in Ireland have the potential to grow between 11 to 15 tonnes of grass dry matter per hectare annually. However, total annual grass DM production varies considerably across farms, depending on location, farm type, season, and grazing management decisions applied. Herbage utilisation at farm level can be increased through the measuring and budgeting of pastures and the use of rotational grazing systems. The main objective of grassland management for sheep systems is to supply high quality digestible pastures to the grazing ewe and her lambs. Growing as much grass as the farm needs should be the first step in any farm plan. The next step will be how to best utilise the grass and produce as much lamb output from it as possible in a profitable manner. Grazing management and infrastructure, as mentioned above, will play a big part in this but stocking rate and the type of animal on the farm will also have significant effects. The optimal stocking rate for individual farms is dictated by the grass growing potential of that farm i.e. stock the farm to maximise utilisation of grass grown.

## Grass10

Grass10 is a four year campaign launched by Teagasc with the support of industry partners to promote sustainable grassland excellence. The Grass10 campaign will play an important part in increasing grass growth and utilisation on Irish farms. It is estimated that the average drystock farm in Ireland utilises approximately 5.6 tons of grass DM/ha/yr. It is estimated that every additional 1 ton of grass DM/ha utilised will increase profit by €105/ha on drystock farms. Results from recent grassland systems research in Athenry show that every 1 ton of grass DM grown will support a ewe plus her lambs for a year including winter feed. Data from Athenry and commercial sheep farms participating in the Teagasc BETTER sheep farm programme indicates that there is room for significant increases in the level of grass grown and utilised on Irish sheep farms. One of the main objectives of the Grass10 campaign is to increase grass utilised on farm to 10tons of grass DM/ha. In order to achieve this there are five key areas that we must focus on:

1. Soil fertility
2. Field division/grazing groups
3. Grazing management plan
4. Measurement/budgeting
5. Reseeding

## 1. Soil fertility

Productive soils underpin any successful farming system. Pastures will not perform to their potential if soil fertility is not correct. The soil's ability to provide the appropriate quantity of nutrient at the appropriate time for grass growth determines the productivity of a field, and consequently soil fertility should be foremost in the mind of those who wish to maximise the return from grazed grass. The exact quantities of lime and fertilisers required can be gauged from a soil test which should be carried out every 3-5 years with the results incorporated into a plan for fertiliser and lime applications. A soil test can be carried out by your local Teagasc advisor or private company. Fertiliser can account for up to one fifth of the total variable costs on sheep farms so effective management of this commodity has potential to save money. A liming programme should be in place on all farms in order to have soil pH at its optimum year on year. This will prevent soil pH from dropping to such an extent that the release of nutrients and the response to applied fertiliser will be compromised. Table 1 shows the percentage of soil samples tested in 2016 that were at optimum levels for soil pH, P and K. As can be seen, there is considerable room for improvement.

**Table 1.** Percentage of drystock farms at optimum levels of soil fertility to grow grass in 2016

| Parameter | National | Galway | Monaghan |
|---|---|---|---|
| Soil pH (>6.2) | 32% | 40% | 39% |
| Soil P (index 3 or 4) | 36% | 40% | 32% |
| Soil K (index 3 or 4) | 42% | 30% | 57% |
| Good overall fertility | 9% | 7% | 11% |

Source: *Teagasc*

## 2. Field division/grazing groups

Set stocking/continuous grazing systems are commonly operated on Irish sheep farms, with sheep grazing the same grassland area throughout the grazing season. Rotational grazing systems offer greater flexibility in grassland management by providing increased control over sward structure, grazing severity, regrowth periods and overall pasture supply. This involves dividing the grassland area into a number of paddocks, which are then grazed, fertilised and rested in turn and can allow greater levels of herbage utilisation be achieved. On the research demonstration farm in Athenry a simple 5 paddock rotational grazing system is used which can also be split temporarily as needed to give up to 10 grazing divisions per group. Average residency time in paddocks in April, May and June is 5 days. Post weaning a leader follower system is practiced with lambs having first access to fresh regrowth , grazing to around 6cm, with the dry ewes then grazing out paddocks to 4cm to ensure quality leafy grass in the following rotation. Average residency time in paddocks is 5 days for each group, (5 days for lambs and 5 days for ewes). The paddocks are always subdivided at this time so sheep are moving every 2-3 days. This keeps fresh grass in front of lambs and allows the ewes clean out residuals quickly to allow grass to begin growing again. This form of grassland management maximizes grass growth and utilisation while maintaining animal performance as quality is more easily controlled. Rotation length is extended in the shoulder periods of spring and autumn to allow for lower grass growth rates with an average residency time of 8 days in March/early April (First rotation 40 days) and 10 days in Autumn (last rotation 50 days). A general recommendation with regard to paddock size taking an example of a farm with a flock of 100 ewes stocked at 10 ewes/ha would be a minimum of 5 paddocks of 2ha (5 ac) each per grazing group, which could be further divided using temporary fencing as required.

Using all the grassland production and utilisation information gathered from the grazing trials on the Research Demonstration farm over the past number of years there may be scope to increase grass production and utilisation even further by employing a 6 paddock rotational grazing system with each paddock 1.6ha (4ac) in size, which from analysis of our data would show a possible increase in grass production and utilisation per hectare of approximately 15%. This is backed up by Pasturebase Ireland data which shows a strong relationship between the number of paddocks per farm and the total number of grazings achieved per farm. It has identified that the advantage of creating one new paddock on a farm will give five extra grazings from the farm annually. A key finding from the grazing performance of drystock farms recording on PBI showed the greater the number of grazings achieved, the higher the grass DM production produced. Every extra grazing achieved increased annual grass DM production by 1.5 t DM/ha. Again making greater use of temporary fencing in conjunction with strategically placed permanent fences can allow paddock number and size to be more accurately allocated based on group size and grass cover available.

## 3. Grazing management plan

When we talk about grazing management we need to divide the grazing season into three sections; autumn, spring and mid-season.

### *Autumn*

Autumn is the starting point of the grassland year. Management and decisions made in this period have a direct effect on the quality and availability of grass the following spring. To ensure adequate grass availability for ewes at lambing in March you should begin to close paddocks from mid to late October onwards. Table 2 outlines a suggested autumn closing plan for mid-season lambing flocks based on data from the Research Demonstration farm in Athenry.

This is important so we can build cover while grass growth is still active. Very little grass will be grown during December and January. When grass growth starts to increase again in February and March it is the earlier closed fields that will respond quickest to the increasing temperatures and an early application of fertiliser. Where winter housing is not available or practical ewes can be managed in an extended grazing system on grass built up earlier in the autumn with grass allocated daily or every second day.

**Table 2.** Suggested autumn closing plan for mid-season lambing flocks.

| Date | % Area closed | +120 days |
|---|---|---|
| Late Oct | 20 | Early Mar |
| Mid Nov | 40 | Mid Mar |
| Late Nov | 60 | Late Mar |
| Mid Dec | 80 | Early Apr |

Based on early March lambing flock, 120 day rest period over winter

Ewes could also be wintered on forage crops, or with hay/silage and concentrate supplementation outdoors. The important thing is that the sheep are confined to a smaller area of the farm (less than 20%) allowing grass supplies to build on the majority of the area. Having put a closing plan into action it may also be necessary over time to review mating and consequently lambing dates to better match the spring grass growing potential of your farm to meet flock demand e.g. lambing too early and exhausting built up grass reserves before grass growth is strong enough to keep up with the rising demand as ewes move through lactation and lambs begin grazing. The temptation to re-graze closed fields in December/January will always be there, especially in years where autumn grass supply is good or where winter feed reserves are low or poor quality but this grass is worth much more in the spring to the freshly lambed ewe than in mid pregnancy. A ewe's feed requirement in mid pregnancy is approximately half that of a ewe in early lactation producing milk for two lambs. The first paddocks closed should be sheltered and close to the lambing area. Where autumn grass covers are high an electric fence can be used to reduce the area available for grazing at any one time to make ewes graze down to the desired post grazing height of around 4cm. It is important to clean swards out as tight as possible when closing as carrying higher residuals over winter will lead to a lot of dead material accumulating at the base of the sward which will depress grass growth in the spring and reduce quality.

### *Spring*

Having started your grazing plan for the year the previous autumn all going according to plan ewes can be turned out to grass as they lamb with minimal supplementary feeding, if any, required post turn-out. From a management, cost and labour point of few, this must be the aim. To boost spring grass supply nitrogen should be applied in early February or once soil temperatures reach 5-6°C (the threshold for grass growth). Urea should be used once conditions are not overly dry at a rate of 23 units/acre (half bag/ac). Grassland management in the first and second rotations in spring has a significant effect on the quality of swards available to the growing lamb in subsequent grazings. It is worth remembering that the majority of the lamb's feed intake during this time will be coming from milk.

The aim must be to graze swards out to 3.5-4cm in March and April to ensure high quality leafy regrowths. The first rotation should be finished by mid-April. This will result in fresh leafy regrowths coming into the system when the grazing demand of the lamb begins to increase. If swards are allowed to build up stemmy material early in the season the quality of swards available later in the year will be poor and consequently lamb performance will suffer.

### *Midseason*

During the main grazing season the objective is to achieve high animal performance from an all grass diet. From late April onwards grass turns from vegetative (leafy) to reproductive (stemmy) state. This is a large management issue for grassland farmers. The aim must be to increase the quality of the grass allocated rather than the quantity offered; this is achieved by ensuring there is a high quantity of leaf in the sward. Grazing lower grass covers of 1100-1300 kg DM/ha (7-8cm), while maintaining a rotation length of between 17-21 days will help maintain grass quality in the May to July period. Stronger covers of grass 10cm+ (2000 + kg DM/ha) should not be grazed as utilisation levels will be lower but instead can be conserved as high quality baled silage.

During the mid-season, when a plant starts to head it produces a reproductive stem. This changes the balance of the plant from producing green leaf to producing high stem proportions. Green leaf content is directly related to grass digestibility. A 5.5% change in leaf content is equal to a 1-unit change in digestibility. Poorly managed swards can result in large reductions in green leaf content to just 50% leaf during the reproductive period. Well grazed swards (4.0 – 4.5 cm post-grazing sward height) will contain a high proportion of leaf in the mid grazing horizon (4 to 10 cm). Sheep farmers must adopt a policy of offering swards with high leaf content throughout the season.

## 4. Measurement/budgeting

With the basic building blocks of soil fertility, infrastructure and management in place the next step to getting more from grass is to develop grass measurement and budgeting skills. Grass measurement and budgeting does not have to be complicated or expensive as is often the perception. There are a number of methods that can be used to measure grass supply on farms. The use of sward sticks, rising plate meters and the quadrant and shears method are all common. What method you use is irrelevant, the important thing is that some form of measurement is carried out on a regular basis which can be used to aid management decisions. To try and manage any business without knowing what the current and projected future basic inputs may be would not be accepted by the majority and sheep farming and grassland management should be no different. Teagasc has developed an online grassland management decision support tool Pasturebase Ireland (PBI) in 2013.

Pasturebase Ireland enables the farmer to keep track of grass growth per paddock, the number of grazings per paddock and the quantity of grass being consumed at each grazing. This highlights poor performing paddocks and deficiencies in grazing management. This programme is free to use and simply involves registering with your email address to open an account. This programme allows you to input grassland measurements and information on stock numbers. Using this information grassland management advice is generated based on your current grass supply and demand status to aid decision making on your farm. Table 3 shows an example of grassland management guidelines developed through grazing trials on the Research Demonstration farm in Athenry that can be used to more accurately manage grass during the main grazing season to improve the management, utilisation and quality of swards offered.

**Table 3.** Grass cover and days-ahead guidelines for sheep farms

| | Kg grass DM/L.U | Days-ahead |
|---|---|---|
| M Apr | 300 | 20 |
| E May | 250 | 15 |
| M May | 250 | 12.5 |
| E June | 200 | 10 |
| Mid June | 200 | 10 |
| E July | 200 | 15 |
| Mid July | 200 | 15 |
| E Aug | 250 | 17 |
| M Aug | 250 | 17 |
| E Sept | 250 | 20 |
| M Sept | 300 | 25 |
| E Oct | 350 | 30 |
| M Oct | 400 | 40 |

## 5. Reseeding

Grass utilised/ha is a consequence of grass grown/ha, stocking rate and grassland management. Perennial ryegrass is a high quality feed and is more responsive to available nutrients than other grass species. Research has shown that old permanent pasture produces, on average, 3 t DM/ha less than reseeded perennial ryegrass swards. There are many beneficial reasons for reseeding as perennial ryegrass dominant pastures:

- Provide more grass in the shoulder periods of early spring and late autumn.
- Are 25% more responsive to nitrogen compared to old permanent pasture.
- Have faster re-growth.
- Support higher stocking rates.

As well as having more grass in early spring and late autumn newly reseeded swards are more responsive to nitrogen. This means that compared to old permanent pastures reseeded swards yield more grass per kg of nitrogen applied. Figure 1 shows the spring and autumn DM production of two pastures, an old permanent pasture and a new reseed. It is clear that the reseeded pasture with its high perennial ryegrass content produces more grass in spring and autumn compared to the old permanent pasture (30% perennial ryegrass) which will not support early or late grazing systems as insufficient grass is being produced. However, reseeding is not cheap, costing up to €700/ha (€285/ac) to complete. Reseeding must be combined with improvements in management, utilisation and where necessary increasing, soil fertility to harness the true benefit. As the final part of the grass growth and utilisation improvement plan it can increase profitability by up to €300/ha per year through improved grass DM production and increased nitrogen use efficiency during the growing season. The increased profitability of the reseeded pasture would cover the reseeding cost in just over two years. This means reseeding is one of the most cost effective on-farm investments.

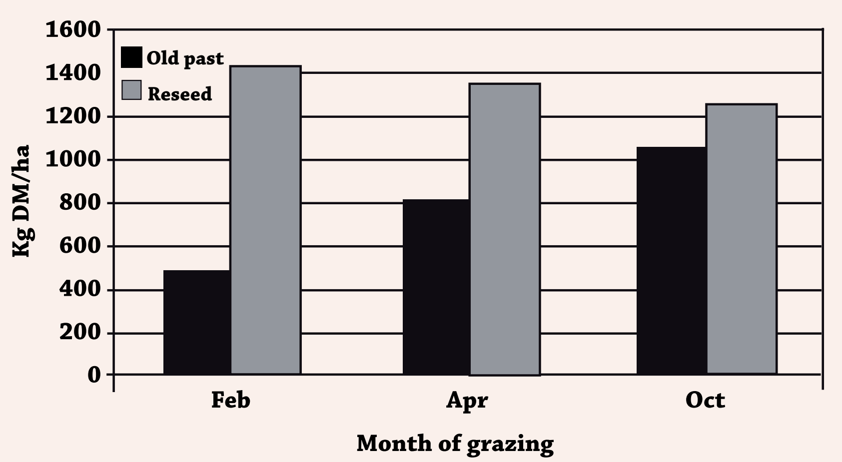


**Figure 1.** Effect of pasture perennial ryegrass content on DM yield.

## Why should we focus on growing and utilising more grass?

Ireland's strength in sheep production lies in its ability to produce meat from an almost entirely grass based diet thus giving us a competitive advantage over many of our EU competitors. The main challenge for pasture based systems of sheep production is to improve the utilisation of pasture and increase the output of lamb from grassland. Higher stocking rates and consequent higher output is possible by increasing herbage yield through greater and/or more efficient use of nitrogen (chemical fertilizer or fixed nitrogen) and by achieving better utilisation of herbage in pastures. With grass making up 90-95% of the annual energy requirements of sheep any improvement in the efficiency of production and utilisation greatly increase profitability. Table 4 shows the key current national average performance figures for lowland sheep production systems relative to high performance targets which have been achieved not only within our research studies in Athenry but more importantly have been matched by participants on commercial sheep farms participating in the Teagasc BETTER sheep farm programme. The important points to note here are that 1) the target of utilising 10 tons of grass DM/ha is achievable, 2) higher grass utilisation facilitates increased lamb output/ha and most importantly 3) this increased level of grass utilisation and output results in increases in farm profitability.

**Table 4.** Current national average figures and high performance targets for some of the key performance indicators in Irish mid-season lamb production systems

| | National average* | High performance target |
|---|---|---|
| Stocking rate (ewes/ha) | 7.7 | 12 |
| Lambs weaned/ewe | 1.4 | 1.75 |
| Carcass output/ha | 217 | 420 |
| Nitrogen used (kg/ha) | 73.5 | 132 |
| Concentrates fed (kg/ewe) | 90 | 35 |
| Grass utilised/ha (kg DM) | 5600 | 10000 |
| Gross Margin/ha (€) | 642 | 1000 |

*Teagasc NFS data

## Summary

Great potential exists to increase the level of grass grown and utilised on Irish sheep farms. Through management and the adoption of technologies, improvements can be achieved. Profitable increases in lamb output are underpinned by increases in grass utilisation at farm level. The challenge is to strengthen our ability to convert this natural asset into a quality lamb product and turn that product into profit to build a sustainable business.

## Acknowledgements

The support of industry partners AIB, Irish Farmers Journal, FBD, The Department of Agriculture, Food and the Marine and Grassland Agro in the Grass10 campaign is gratefully acknowledged.

# Late pregnancy feeding: Achieving your goals and avoiding common pitfalls

*Tommy Boland,*
*Associate Professor of Ruminant Nutrition, School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4*

**Take Home Messages**

- Nutrient requirements double during the final two months of pregnancy
- Meeting these nutrient requirements represent a major cost in the annual production cycle
- Maximising forage quality reduces the need for concentrate supplementation
- Late pregnancy feeding is key to ensuring a successful lambing season and maximising subsequent lamb growth rates
- Aim to hold the mid-pregnancy condition of the ewe until lambing, as it will be needing during early lactation to meet the milk production requirement

## Introduction

Late pregnancy represents one of the key stages of the annual production cycle on a sheep farm. During the final two months of pregnancy, the size of the lamb increases by 85%, the ewe must prepare the mammary gland for milk production and colostrum begins to accumulate in the gland. These three processes greatly increase the demand for all nutrients, but particularly energy and protein. Maintaining mid pregnancy body condition score should also be a priority during late pregnancy. These reserves are of more value once the ewe is turned out to pasture. Failure to meet the nutrient requirements during this key period can lead to significant and permanent performance issues within the flock, such as increased lamb mortality, increased ewe mortality and reduced lamb growth rate. Litter size and stocking rate are routinely identified as two of the key performance indicators influencing productivity on Irish sheep farms (Earle et al., 2017) yet there has been little improvement in litter size or associated weaning rate in the last 50 years. One of the key stated objectives of the national flock is to increase the number of lambs weaned per ewe from the current figure of 1.3 to 1.45 by 2025. To achieve this there must be increases in the number of ewes carry twins and triplets, which will lead to a greater focus on how these ewes are being fed. Considerable bodies of research have been conducted in this area, yet as an industry, we still frequently fall short of our performance targets. The objective of this paper is to outline performance targets at lambing, quantify the resources that exist to meet these targets, and put in place a system to match resources to requirements to allow targets to be achieved.

## Identifying targets

In any business one of the main starting points is setting targets (Table 1) or goal for the performance of the business. These are both physical and financial, but the focus at lambing must start with the physical targets. By the time late pregnancy nutrition comes into focus, litter size is already established and can't be increased by late pregnancy nutrition or feeding, however we can certainly influence how many of those lambs survive to weaning. The highest risk period in the lamb's life is the 48 hours just after lambing, approximately 50% of all lamb mortality occurs during this period (Figure 1) with starvation and disease being the two major causes (accounting for 85% of all lambs lost during this period), both of which are influenced by colostrum intake of the lamb. Furthermore, the birth weight of the lamb is a key determinant of survival, small lambs are more likely to die in early life due to hypothermia, even indoors, as they have a large surface area relative to their body weight, while excessively large lambs are more prone to dystocia or difficult birth. However, research clearly shows that larger lambs at birth grow faster, with each 0.5 kg in birth weight translating to 1.5kg increase in weaning weight. Feeding ewes to optimise lamb birth weight then becomes a key target, but it is also dependent on the level of supervision offered at lambing time. If 24 hour supervision is available, lamb birth weight can be pushed to approximately 7 kg for singles, 6 kg for twins and 5 kg for triplets. If more intermittent supervision is offered then these targets should be reduced by approximately 1kg.

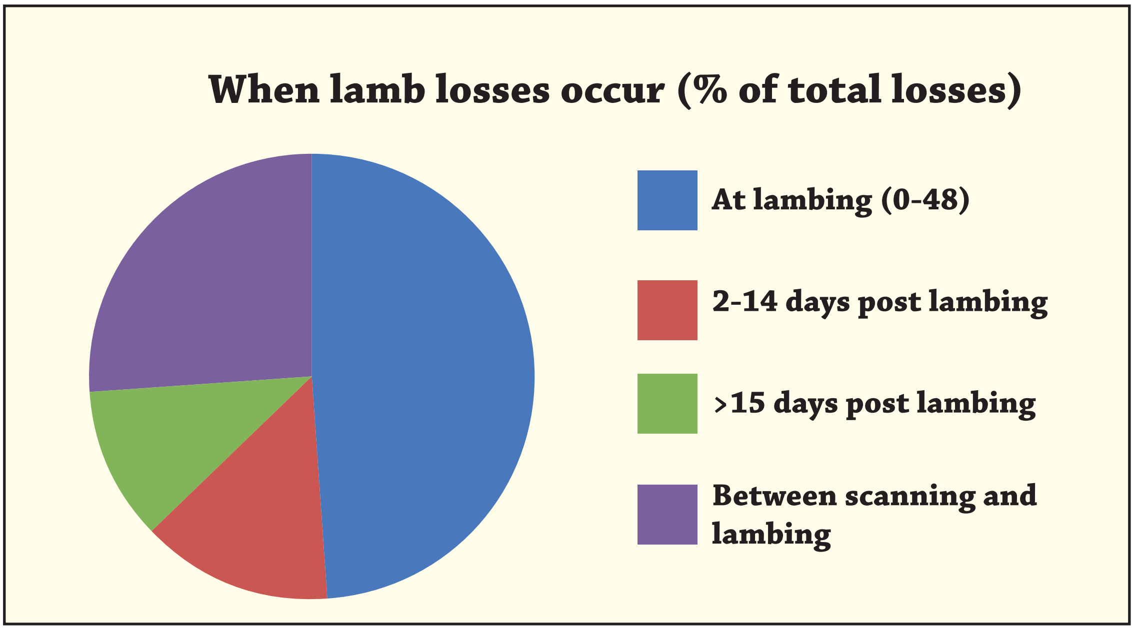


**Fig. 1.** The timing of lamb mortality (Source: HCC lambing project 2010/2011)

Larger lambs add an additional complication, as they require more colostrum, meaning the ewe must produce more colostrum to meet this requirement. Colostrum contains a range of key nutrients, such as energy for heat production, protein and more specifically immunoglobulins for disease prevention and a range of bioactive compounds which have key roles to play in the development of the digestive tract, supporting subsequent lamb growth. Lambs requirements for colostrum are in the region of 200 to 280 ml per kg birth weight in the first 24 hours of life, with the higher requirement occurring at lower temperatures. This means that a ewe giving birth to two live lambs must product a minimum of two litres of colostrum in the first 24 hours of life. In addition to the ewe producing the colostrum, the lamb must consume this colostrum and the lamb's activity is often overlooked in ensuring adequate colostrum intake. Both energy and protein intake, but particularly trace element nutrition in late pregnancy nutrition will influence lambs behaviour after lambing, and hence its ability to suckle and consume colostrum. Iodine, selenium and copper deficiency can reduce a lamb's ability to consume and use colostrum so intake of these key nutrients must be correct during late pregnancy.

Additionally new data shows the volume of colostrum consumed by lambs has a major impact on subsequent lifetime performance, with lambs offered either no colostrum, or reduced colostrum intake have significantly lower growth rates in the post weaning period (Boland et al., 2015). After lambing the aim is to wean lambs at an average minimum weaning weight of 32 kg at 14 weeks of age. In order to achieve this (assuming a 5kg birthweight) lambs must grow at an average of 275 grams per day from birth to weaning. A major deficiency at farm level is a lack of information on lamb growth rates and weaning weights, making it very difficult to measure success in this metric. In terms of ewe performance and ewe survivability, correct feeding is essential to minimise metabolic diseases such as twin lamb disease and milk fever, prolapse and acidosis and ultimately keep ewe mortality below 2% during the lambing period. Milk fever or more correctly hypocalcaemia occurs during late pregnancy when foetal calcium demand increases and this increased demand is not met by dietary intake and or body reserves. Quite often hypocalcaemia is associated with twin lamb disease and or acidosis. Twin lamb disease arises as toxicity from excessive mobilisation of body reserves, as the animal attempts to compensate for a deficiency of dietary intake. In many cases both twin lamb disease and milk fever can prove fatal, so preventative strategies are essential.

**Table 1.** What is my performance in relation to key performance indicators at lambing time?

| | Do I know this? | | If yes | If no | |
|---|---|---|---|---|---|
| | Yes | No | What is it? | What do I think it is? | National Target |
| Lamb mortality | | | | | < 8% |
| Ewe mortality | | | | | 2% |
| Lamb BW<br>-single<br>-twin<br>-triplet | | | | | <br>6kg<br>5kg<br>4.5k |
| Lamb Growth rate to weaning | | | | | 275 grams/day |

## Resources to meet targets

In attempting to meet the above targets the main resources available on farm are the on farm feed resources, feeding/housing facilities and the ewe flock. Key considerations in relation to the resources to meet the stated targets above include, what is ewe live weight, what is the litter size and when will they be born and what is the quality of the conserved forage available? Unfortunately much of this information is often absent, and traditionally we are not good at guessing it?

Farmers are inclined to underestimate ewe live weight. A 70 kg ewe will have a daily maintenance energy requirement of approximately 10 MJ or metabolisable energy (ME). This energy requirement is just about achievable in late pregnancy with average quality grass silage. If the ewe live weight is actually 80 kg this increases maintenance energy requirements by 10%. Assuming a weight of 70kg when the actual weight is greater leads to underfeeding of the animal. The more accurately we can predict lambing date, through the use of technologies such as synchronisation and raddling, the more accurately and economically we can supplement ewes during late pregnancy, with economic efficiencies increasing at high litter sizes. In the absence of the above technologies, or any other data on lambing date/spread, the majority of the ewes within the flock will go in lamb within 21 days of ram introduction, so at the very least, date of ram introduction should be recorded.

Silage quality is a consistent and persistent challenge at farm level for a range of reasons resulting in large variation at farm level in terms of dry matter digestibility (DMD) and protein content (Table 2). There is a disappointingly low uptake of forage testing at farm level, resulting in a situation whereby forage quality is 'estimated' or guessed, resulting in an overestimation of quality. Where the forage quality is unknown and overestimated it becomes difficult to correctly and accurately feed the ewe in late pregnancy. As can be seen from Table 2 the intake potential of the best quality silage is 50% higher than the worst quality silage.

**Table 2.** Mean minimum and maximum quality of baled silage from Teagasc Better Sheep Farm participants 2017

| | **Mean** | **Minimum** | **Maximum** |
|---|---|---|---|
| Dry Matter % | 37.9 | 20.9 | 59.4 |
| pH | 4.7 | 4 | 4.5 |
| Ammonia (% of total Nitrogen) | 9.5 | 7 | 15 |
| Protein (% of DM) | 12.6 | 8.2 | 16.2 |
| *ME (MJ/kg DM) | 11.2 | 10 | 12.1 |
| **DMD (% DM) | 73 | 62 | 80 |
| ***HFIS (g/kg LW0.75) | 93.8 | 69 | 105 |

*Metabolisable Energy; **Dry matter digestibility; ***Hillsborough Feeding Information System intake prediction

## Feeding the ewe

During the final two months of pregnancy 85% of foetal growth takes place and ewe requirements (70kg ewe carrying two lambs) leading to energy, protein and calcium requirements all increase by approximately 100% during this time. For an indoor housed system, these requirements can be met by forage (contribution should be maximised), concentrate (used to make up the difference between forage intake and ewe requirements) or body reserve mobilisation (should be minimised/eliminated, as this is more valuable in early lactation). Forage quality is central to a successful late pregnancy feeding program. Higher quality forage reduces the requirement for concentrate supplementation (Table 3) with a three-fold increase in concentrate requirements as forage quality declines from 79 to 64% DMD. This arises from two issues with low DMD silage, firstly intake is restricted and secondly for each gram of silage consumed, the energy supply is reduced as less of that silage is actually broken down. This results in a situation where extra concentrates are required to meet ewe requirements.

**Table 3.** The effect of silage quality and processing on total concentrate requirement during late pregnancy (Keady, 2017)

| | Silage Dry Matter Digestibility (%) | | |
|---|---|---|---|
| | 79 | 72 | 64 |
| Precision chopped | 8 | 17 | 25 |
| Big bale/single chop | 12 | 24 | 35 |

Adapted Keady, 2017

### *Key considerations in late pregnancy forage feeding*

- Conduct a forage quality test
- Offer high quality forage in the final six weeks of pregnancy
- Provide continuous access to the forage with adequate feed space (minimum of 150 mm or six inches per animal)
- Avoid low dry matter silage (reduced intake and increased bedding requirement)
- Avoid silages with clay contamination
- Bid bale or single chop silage will reduce intakes by 25%
- Poorly preserved silages (high ammonia and butyric acid contents) are less acceptable to sheep

### *Key considerations in supplementing forages with concentrates*

- In the absence of all other information assume a maximum silage intake of 1 kg DM and base concentrate supplementation decisions on this level of intake
- Feed high quality energy (cereal grains) and protein (soyabean meal) sources
- Have sufficient feed space available to allow all ewes to eat concentrates at the same time (minimum of 500 mm per animal)
- Ensure mineral requirements are met through a combination of forage and concentrate sources with mineral supplementation used to make up any deficits.
- If feeding more than 0.5kg of concentrates per day split into 2 feeds. If above 1.0 kg per day split into 3 feeds. This is especially important where forage quality is poor. Poor quality forage spends a long time in the rumen as it takes the microbes more time to break it down. When concentrates are consumed, the rumen pH drops and the microbes in the rumen responsible for digesting the forage are negatively impacted. This means it takes longer to break down the forage. By spreading out the concentrates as described above we reduce this negative impact on the rumen. A build-up of forage in the rumen is implicated in an increased incidence of prolapse especially in smaller, multiple bearing ewes. Additionally this reduced rumen function can contribute to twin lamb disease, as the rate of feed digestion is reduced, less energy is obtained from the feed and the ewe begins to break down body reserves to meet the deficit. Excessive body reserve breakdown leads to a build-up of ketones in the blood stream which can result in twin lamb disease.

***Key considerations to maximise colostrum intake by the lamb***

- The ewe should produce 1 litre of colostrum per lamb born in the first 24 hours of life
- 250 ml of this must be available per lamb at birth
- Correct nutrition as described above will give the best chance of achieving this
- Ensure the lamb can access this colostrum, by removing the wax seal in the teat and any excess wool around the udder
- The lamb must be vigorous at birth (as influenced by trace element nutrition of the ewe)
- If the ewe does not have colostrum or the lamb cannot suckle the lamb should be stomach tubed with 50 ml of colostrum per kg birth weight assuming the lamb is otherwise healthy If artificial colostrum is used follow manufactures instructions

***Key considerations in lamb growth rate after lambing***

- In order to meet milk production the nutrient requirements of the ewe increase by as much as 70-80% in the first 3 weeks of lactation. Intake does not increase as rapidly so the ewe must mobilise body reserves to meet requirements
- Maintain mid pregnancy body condition during late pregnancy so it is available for mobilisation in early lactation.
- If a ewe mobilises half of one body condition score during early lactation it supplies energy equivalent to 17.5 kg of barley.
- Ensuring adequate colostrum intake maximises the lambs ability to grow, as bioactive compounds in colostrum prime the lambs digestive system for post-natal growth.

## Conclusion

The many nutritional challenges facing the ewe during late pregnancy must be managed in order to avoid a detrimental lambing outcome. While a one size fits all approach does not exist, a range of common principles apply: the more information we have in terms of animal requirements and feed quality, the easier it is to manage the feeding program. Inappropriate nutrition, be it under feeding or over feeding can lead to negative outcomes, not all of which will be immediately evident at lambing time. Metabolic diseases are very difficult to treat, so they must be prevented. It is essential to set targets, and assess how you perform in relation to those targets over time. A correctly fed ewe gives the maximum chance of a successful lambing outcome.

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# Does leaving lambs entire affect their meat quality?

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## Take Home Messages

- On an intensive all-concentrate diet, rams lambs had higher growth rates, better feed conversion efficiencies (FCE) than wether lambs.
- Wether lambs had higher KO rates and produced carcases that were fatter at slaughter
- Texel X Scottish Blackface lambs had higher growths, better FCE, better conformation, higher KO% and produced leaner carcasses that Scottish Blackface lambs.
- There were small differences in proximate composition and colour measureemnts between meat from rams and wethers.
- Differences between the rams and the wethers (in favour of wethers), although numerically small, were statistically significant for 11 sensory descriptors.
- Differences between Texel X Scottish Blackface and Scottish Blackface lambs, again though numerically small, were statistically significant for a range sensory descriptors.
- Whether producers castrate lambs or not will depend on their production system, time of lamb finishing, flock size, ability to separate ewe and ram lambs in the autumn and as well as the signal from the market place.
- If processors require more castrate lambs its probable that they will have to reward producers by paying a premium for such lambs

## Introduction

In Ireland the practice of castrating lambs has declined over the past decade. The use of entire ram lambs in production systems is favoured, at least in part, because of their increased growth rates and their ability to utilise feed more efficiently while producing a leaner carcass. The supply of a consistent product, which consumers will repeatedly purchase, is critically important to the sheep industry. Critical characteristics include physical appearance and tenderness of the meat as well as taste and off flavour. Some processors and producer groups have expressed concern that leaving male lambs entire undermines the market for lamb because consumers find the eating quality of meat from entire male lambs unsatisfactory. This paper summarizes the results of a series of recently completed Teagasc–University College Dublin studies which compared ram and wether lambs fed on a short-term (36-day) all-concentrate diet prior to slaughter The studies report on 1) carcass and meat composition 2) meat tenderness and collagen content and 3) post-slaughter muscle pH, temperature profile, colour attributes, aroma, flavour and texture attributes.

## Experimental

A total of 120 Scottish Blackface and 120 Texel × Scottish Blackface lambs were identified, tagged and date of birth recorded, on 6 commercial farms. Each alternate male lamb born alive was castrated using a scrotal rubber ring within 48 h of birth. At 5 months of age lambs were weighed and inspected visually on all 6 source farms to confirm sex and disease free status before being transported to the Teagasc Research Centre at Athenry. On arrival at the research centre lambs completed a bio-security protocol and were treated for internal and external parasites. Lambs were then placed on pasture until selected for the 36-day indoor intensive finishing period. Within breed and sex, the ten heaviest lambs were selected for the finishing period for each of the five slaughter time points. Lambs were individually housed on expanded metal feeding pens for the 36 d indoor finishing period. During the finishing period lambs (100 Scottish Blackface and 100 Texel x Scottish Blackface) were allowed tactile, olfactory and visual contact with each other through the pen partitions and had visual and tactile contact with non-pregnant cyclic ewes. For the duration of the 36-d finishing period lambs were offered 100 g/d DM of silage and had access to *ad libitum* concentrate feed and water. Lambs were slaughtered following the 36-d finishing period. Carcasses were graded for conformation using the EUROP scale and subcutaneous fat cover using a 1 to 5 scale (1=low fat cover, 5=excess fat tissue cover). The right side of each carcass was de-boned at 24 h post-mortem. Steaks were cut from the loin. The first steak was used for muscle colour assessment. Following this the remaining steaks were vacuum packed, aged for 8 days at 4 °C, frozen at –20 °C and, subsequently, used for Warner-Bratzler shear force (WBSF) tenderness measurements, total collagen content and proximate composition measurements, carcass pH and temperature measurements and sensory analysis.

## Sensory Analysis

Loin muscle samples from the left side of each carcass was used for sensory analysis. On the days of the sensory tasting, frozen steaks were thawed, grilled and randomly served to 8 trained panellists. Prospective sensory panellists were selected based on their availability, their interest in the project and their sensitivity as assessors following two screening sessions. Panellists participated in 16 training sessions. In the initial training sessions, a range of samples bearing the flavours and off-flavours similar to those of interest were used. Samples of lamb meat, some with adhering fat, were presented to panellists who described the sensory attributes they perceived and generated descriptors for flavour, aroma, texture/mouthfeel, taste and aftertaste. In addition, in two sessions panellists received lamb samples spiked with some of the recognised lamb flavour/aroma compounds (i.e. branched-chain fatty acids, skatole, indole, p/m-cresol and 3-methylpentanoic acid) to aid in the generation of aroma descriptors. Sessions using physical and chemical reference standards were run so that the panellists would learn to differentiate and identify the sensory descriptors. Training in the intensities of odour, flavour and texture (chewiness, tenderness and juiciness) was done based on published methodologies. Panellists were asked to rate 38 attributes (generated during the training) for each sample, by marking a point on a 100 mm unstructured line scale. The sensory attribute definitions, agreed during the training sessions, were available to each panellist during tasting.

## Results

While the study was designed to evaluate 3-way and 2-way interactions (among breed, sex and slaughter age) no 3-way and few 2-way interactions were detected, indicating that the effect of sex was largely consistent across both breed types and ages of slaughter. Production data and carcass data for SB and TXSB lambs is summarised in Table 1 .

**Table 1.** Average production and carcass traits data for Scottish Blackface (SB) and Texel X Scottish Blackface (T×SB) lambs

| Variable | Breed type | | Standard error of mean | Statistical significance |
|---|---|---|---|---|
| | SB | T×SB | | |
| **Production Traits** | | | | |
| Start weight, kg | 36.9 | 41.2 | 0.26 | Higher for T×SB |
| Slaughter weight, kg | 45.7 | 53.7 | 0.41 | Higher for T×SB |
| Average daily gain (ADG) g/d | 241 | 349 | 7.0 | Higher for T×SB |
| Total Intake, kg[1] | 53.7 | 59.4 | 0.79 | Higher for T×SB |
| Daily intake day 0-14,kg/d | 1.44 | 1.61 | 0.021 | Higher for T×SB |
| Daily intake day 15-36, kg/d | 1.53 | 1.66 | 0.022 | Higher for T×SB |
| FCE[2], kg | 6.74 | 5.17 | 0.201 | Lower for T×SB |
| **Carcass Traits** | | | | |
| Kill out, % | 45.4 | 47.9 | 0.215 | Higher for T×SB |
| Carcass fat score[3] | 3.77 | 3.21 | 0.096 | Higher for SB |
| Carcass conformation score[4] | 2.63 | 3.38 | 0.084 | Higher for T×SB |
| Carcass weight, kg | 20.7 | 25.7 | 0.208 | Higher for T×SB |

[1]Total Intake (Fresh matter weight) =Total concentrate intake, [2]FCE calculated as total feed intake divided by total weight gain, [3]1 to 5 scale (1=low fat cover, 5=excess fat tissue), [4]Carcass Conformation EUROP Scale transformed to 5, 4, 3, 2 and 1, respectively.

**Table 2.** Production and carcass traits for ram and wether lambs

| | Gender | | | |
|---|---|---|---|---|
| | Ram | Wether | SEM | Statistical significance |
| **Production Traits** | | | | |
| Start weight, kg | 39.1 | 39.0 | 0.25 | Similar |
| Slaughter weight, kg | 50.5 | 48.9 | 0.41 | Higher for Rams |
| ADG, g/d | 314 | 272 | 7.0 | Higher for Rams |
| Total Intake, kg[1] | 57.1 | 55.9 | 0.66 | Similar |
| Daily intake day 0-14,kg/d | 1.52 | 1.53 | 0.022 | Similar |
| Daily intake day 15-36, kg/d | 1.62 | 1.52 | 0.010 | Similar |
| FCE,[2] kg | 5.58 | 6.31 | 0.200 | Lower for rams |
| **Carcass Traits** | | | | |
| Kill out, % | 45.7 | 47.6 | 0.24 | Higher for wethers |
| Carcass fat score[3] | 3.07 | 3.91 | 0.077 | Higher for wethers |
| Carcass conformation score[4] | 2.92 | 3.10 | 0.068 | Higher for wethers |
| Carcass weight, kg | 23.1 | 23.3 | 0.20 | Similar |
| 25 Hour pH | 5.65 | 5.52 | 0.02 | Higher for Rams |

[1]Total Intake (Fresh matter weight) =Total concentrate intake, [2]FCE calculated as total feed intake divided by total weight gain, [3]1 to 5 scale (1=low fat cover, 5=excess fat tissue),[4]Carcass Conformation EUROP Scale transformed to 5, 4, 3, 2 and 1, respectively.

Texel × Scottish Blackface lambs had higher daily feed intakes and higher growth rate, as demonstrated by ADG, and lower feed conversion efficiency (FCE), which is highly desirable, than Scottish Blackface lambs. Kill- out rates were 2.5 percentage points higher, conformation score was almost 0.75 of a unit higher and carcass fat score 0.56 of a unit lower for Texel × Scottish Blackface lambs. Production data and carcass data for ram and wether lambs from both breed types is summarised in Table 2. Ram lambs had higher growth rates, produced heavier carcasses and had lower feed conversion efficiency (FCE) than wether lambs. Feed intake was similar in both. Wether lambs had an almost 2% percentage point higher kill-out rate, had marginally higher conformation score (0.18 of a unit) but were much fatter (0.84 of a unit). The higher fat score in wethers is possibly a reflection of the high energy diet they were on prior to slaughter.

## Chemical analysis and colour

Intramuscular fat (IMF) can be a key indicator of meat eating quality. IMF levels of between 3% and 5% are said to result in the best eating quality. Scottish Blackface lambs had higher levels of IMF compared to T×SB while no difference was observed between genders for IMF. Protein, ash and moisture levels did not differ between either breed or gender. The colour of the meat is important to consumers at time of purchase as an indicator of freshness. Consumers will generally choose meat which is bright and red rather than darker meat. L* (lightness of meat colour) values indicate how light or dark coloured the meat is with consumers having a preference for lighter coloured meat. While the meat from SB lambs was statistically lighter in colour than meat from T×SB the differences were very small and meat from both breed types was very acceptable. A* (redness of meat colour) and b* (yellowness of meat colour) were both was statistically higher in the meat from wether lambs compared to ram lambs but again the differences were very small and meat from both genders was very acceptable.

Small differences were observed for pH at 25 hours post slaughter in wether and ram lambs while no differences were observed between the two breed types. A pH > 5.8 can lead to increase toughness and also lead darker coloured meat which is not acceptable to consumers. In this study no pH values of >5.8 were recorded at 25 hours post slaughter which would indicate that high pH was not an issue across both breed types and genders. There were no differences in temperature at 25 hours post slaughter between breeds or genders.

**Table 3 .** Average for different meat quality attributes of Scottish Blackface (SB) and Texel cross Scottish Blackface (T×SB) lambs.

| | Breed type | | SEM | Statistical significance |
|---|---|---|---|---|
| | SB | T×SB | | |
| **Proximate compositional (g/kg)** | | | | |
| Moisture | 74.21 | 74.47 | 0.092 | Higher in T×SB |
| Protein | 21.24 | 21.60 | 0.059 | Higher in T×SB |
| Intramuscular fat | 3.23 | 2.56 | 0.098 | Higher in SB |
| Ash | 1.11 | 1.14 | 0.001 | Similar |
| Tenderness (N)[1] | 34.15 | 37.20 | 1.07 | Similar |
| Cooking loss (%) | 27.55 | 30.35 | 0.784 | Higher in T×SB |
| Total Collagen (g/kg) | 3.23 | 2.68 | 0.013 | Higher in SB |
| 25 Hour pH | 5.61 | 5.55 | 0.02 | Similar |
| **Colour** | | | | |
| *L** (lightness) | 44.02 | 45.27 | 0.221 | Higher in T×SB |
| a* (Redness) | 19.29 | 19.77 | 0.250 | Similar |
| b* (Yellowness) | 6.74 | 7.05 | 0.129 | Higher for T×SB |

Colour measurements: L* = lightness, 0 (black) to 100 (white); a* = redness, +a (red) to –a (green); B* = yellowness, +b (yellow) to –b (blue);

Tenderness values, measured by the Warner Bratzler Shear Force, indicate the force required to cut through a piece of meat and is measured in Newton's (N). This test indicated that meat from SB lambs was more tender than meat from T×SB lambs, while wether lambs meat was tending towards been more tender than ram lamb meat, however, differences were numerically very small. It must be noted that neither meat from castrates or rams was deemed unacceptably tough and this is supported by the sensory analysis for tenderness (Table 5). Cooking loss indicates the percentage weight of the meat lost during the cooking process, this can be an indicator of juiciness of meat and was higher in T×SB lambs than SB, while no differences were noted between genders. A higher cook loss would also lead to a less tender cooked meat so cooked meat from TXSB lambs would be less tender.

**Table 4 .** Average for different meat quality attributes of Scottish Blackface (SB) and Texel cross Scottish Blackface (T×SB) lambs.

| | Gender | | SEM | Statistical significance |
|---|---|---|---|---|
| | Ram | Wether | | |
| **Proximate compositional (g/kg)** | | | | |
| Moisture | 74.74 | 73.95 | 0.092 | Higher in wethers |
| Protein | 21.33 | 21.15 | 0.059 | Similar |
| Intramuscular fat | 2.61 | 3.19 | 0.098 | Higher in wethers |
| Ash | 1.13 | 1.12 | 0.001 | Similar |
| WBSF (N)[1] | 37.10 | 34.20 | 1.53 | Similar |
| Cooking loss (%) | 29.21 | 28.69 | 0.624 | Similar |
| Total Collagen (g/kg) | 2.94 | 2.96 | 0.091 | Similar |
| 25 Hour pH | 5.65 | 5.52 | 0.02 | Higher for Rams |
| **Colour** | | | | |
| *L** (lightness) | 44.72 | 44.58 | 0.221 | Similar |
| a* (Redness) | 18.14 | 20.13 | 0.250 | Higher in Wethers |
| b* (Yellowness) | 6.73 | 7.06 | 0.129 | Higher in Wethers |

Colour measurements: L* = lightness, 0(black) to 100 (white); a* = redness, +a (red) to –a (green); b* = yellowness, +b (yellow) to –b (blue);

Scores for sensory attributes in grilled loin muscle from ram and wether lambs is presented in Table 5, while scores for sensory attributes for SB and T×SB lambs are presented in Table 6. Overall 22 out of 38 sensory descriptors were affected by breed type and gender treatments. The differences between the rams and the wethers, although numerically small, were statistically significant for 11 descriptors. Lamb from rams had higher mean scores for Intensity of Lamb Aroma, Animal Smell/Farm Smell, Woolly Aroma, Rancid Aroma, Manure/Faecal Aroma, Sweaty Aroma, Rancid Flavour, Off-flavours and Fattiness/Greasiness and lower mean scores for Intensity of Roast Meat Aroma and Intensity of Roast Meat Flavour. Differences in Soapy Aroma, Soapy Flavour and Fatty/Greasy Aftertaste were close to statistical significance, respectively, with rams having higher scores than castrates.

**Table 5.** Average scores for sensory attributes in grilled loin muscle from ram and wether lambs

| Sensory attributes | Gender | | SEM | Statistical significance |
|---|---|---|---|---|
| | Ram | Wether | | |
| **Aroma** | | | | |
| Intensity of Roast Meat Aroma | 59.42 | 62.1 | 0.66 | Higher in wethers |
| Intensity of Lamb Aroma | 49.1 | 46.5 | 0.52 | Higher in Rams |
| Grassy Aroma | 13.0 | 12.7 | 0.27 | |
| Aromatic/Herbal | 14.4 | 14.6 | 0.27 | |
| Metallic/Bloody | 19.3 | 18.5 | 0.36 | |
| Animal Smell/Farm Smell | 10.1 | 8.1 | 0.31 | Higher in rams |
| Woolly | 6.2 | 4.9 | 0.31 | Higher in rams |
| Buttery | 17.1 | 17.7 | 0.41 | |
| Fatty | 24.0 | 23.9 | 0.56 | |
| Rancid | 8.0 | 6.3 | 0.30 | Higher in rams |
| Manure/Faecal | 5.0 | 3.9 | 0.24 | Higher in rams |
| Sour | 6.5 | 5.9 | 0.24 | |
| Sweaty | 10.4 | 8.9 | 0.35 | Higher in rams |
| Soapy | 4.4 | 3.8 | 0.16 | |
| Earthy | 7.7 | 7.7 | 0.22 | |
| **Flavour** | | | | |
| Intensity of Roast Meat Flavour | 48.9 | 54.0 | 0.68 | Higher in Wether |
| Intensity of Lamb Flavour | 49.5 | 50.6 | 0.50 | |
| Grassy | 10.8 | 11.3 | 0.25 | |
| Metallic/Bloody | 36.2 | 35.4 | 0.64 | |
| Aromatic/Herbal | 10.8 | 10.8 | 0.30 | |
| Soapy | 6.7 | 5.8 | 0.22 | Higher in rams |
| Rancid | 9.1 | 7.0 | 0.35 | Higher in rams |
| Farmyard | 10.2 | 8.6 | 0.37 | |
| Sour | 9.7 | 8.9 | 0.31 | |
| Sweet | 5.8 | 6.5 | 0.25 | |
| Off-flavours | 13.0 | 9.7 | 0.58 | Higher in rams |
| **Texture** | | | | |
| Tenderness | 60.4 | 62.6 | 1.05 | |
| Juiciness | 46.4 | 47.7 | 0.71 | |
| Chewiness | 41.4 | 41.8 | 1.00 | |
| Fattiness/Greasiness | 33.3 | 31.3 | 0.51 | Higher in rams |
| Stringiness/Fibrousness | 30.3 | 32.6 | 0.82 | |
| Stickiness | 26.1 | 28.0 | 0.59 | |
| **Aftertaste** | | | | |
| Intensity of Lamb Aftertaste | 43.8 | 44.5 | 0.44 | |
| Soapy | 10.9 | 10.3 | 0.26 | |
| Metallic/Bloody | 37.4 | 36.1 | 0.67 | |
| Fatty/ Greasy | 22.1 | 20.6 | 0.41 | |
| Dry | 14.7 | 15.0 | 0.40 | |
| Astringent | 12.9 | 13.1 | 0.38 | |

Mean values for attributes evaluated on a 100-point unstructured line scale (0 = low intensity; 100 = high intensity)

**Table 6.** Average scores for sensory attributes in grilled loin muscle from SB and T×SB lambs

| Sensory attributes | Breed (B) SB | T×SB | SEM | Statistical significance |
|---|---|---|---|---|
| **Aroma** | | | | |
| Intensity of Roast Meat Aroma | 61.1 | 60.3 | 0.66 | |
| Intensity of Lamb Aroma | 49.6 | 45.9 | 0.52 | Higher in SB |
| Grassy Aroma | 12.7 | 13.0 | 0.27 | |
| Aromatic/Herbal | 13.7 | 15.3 | 0.27 | Higher in T×SB |
| Metallic/Bloody | 19.0 | 18.8 | 0.36 | |
| Animal Smell/Farm Smell | 8.6 | 9.6 | 0.31 | |
| Woolly | 5.4 | 5.7 | 0.31 | |
| Buttery | 17.4 | 17.4 | 0.41 | |
| Fatty | 24.6 | 23.3 | 0.56 | |
| Rancid | 7.0 | 7.3 | 0.30 | |
| Manure/Faecal | 4.3 | 4.6 | 0.24 | |
| Sour | 5.9 | 6.5 | 0.24 | |
| Sweaty | 9.5 | 9.8 | 0.35 | |
| Soapy | 3.7 | 4.6 | 0.16 | Higher in T×SB |
| Earthy | 7.7 | 7.7 | 0.22 | |
| **Flavour** | | | | |
| Intensity of Roast Meat Flavour | 51.4 | 51.5 | 0.68 | |
| Intensity of Lamb Flavour | 52.0 | 48.1 | 0.50 | |
| Grassy | 10.9 | 11.1 | 0.25 | |
| Metallic/Bloody | 36.1 | 35.5 | 0.64 | |
| Aromatic/Herbal | 10.5 | 11.1 | 0.30 | |
| Soapy | 5.9 | 6.6 | 0.22 | |
| Rancid | 7.6 | 8.6 | 0.35 | |
| Farmyard | 9.2 | 9.7 | 0.37 | |
| Sour | 8.5 | 10.1 | 0.31 | Higher in T×SB |
| Sweet | 6.2 | 6.2 | 0.25 | |
| Off-flavours | 10.3 | 12.4 | 0.58 | Higher in T×SB |
| **Texture** | | | | |
| Tenderness | 65.0 | 58.0 | 1.05 | Higher in SB |
| Juiciness | 48.8 | 45.3 | 0.71 | Higher in SB |
| Chewiness | 38.2 | 45.0 | 1.00 | Higher in T×SB |
| Fattiness/Greasiness | 33.1 | 31.4 | 0.51 | |
| Stringiness/Fibrousness | 27.7 | 35.2 | 0.82 | Higher in T×SB |
| Stickiness | 25.8 | 28.3 | 0.59 | Higher in T×SB |
| **Aftertaste** | | | | |
| Intensity of Lamb Aftertaste | 45.2 | 43.1 | 0.44 | Higher in SB |
| Soapy | 10.2 | 11.0 | 0.26 | |
| Metallic/Bloody | 36.7 | 36.8 | 0.67 | |
| Fatty/ Greasy | 21.9 | 20.9 | 0.41 | |
| Dry | 13.9 | 15.9 | 0.40 | Higher in T×SB |
| Astringent | 12.3 | 13.6 | 0.38 | |

Mean values for attributes evaluated on a 100-point unstructured line scale (0 = low intensity; 100 = high intensity)

The Median Absolute Deviation (MAD) statistic was applied to determine the extent to which sensory scores could be considered "extreme" or outliers and was applied to 7 sensory attributes considered "undesirable". These were - Animal smell/ farm smell, woolly aroma, rancid aroma, manure/faecal aroma, off- flavours, rancid flavour, farmyard flavour. These indicated the percentage of animals within gender and breed type categories that exceeded an arbitrary cut-off for so called "undesirable" attributes (Table 7).

[1]Percentage of animals with one or more "undesirable" attribute.

**Table 7.** Percentage of animals per gender and breed that exceeded the cut-off point for seven "undesirable" attributes using the statistic.

| | Texel x Scottish Blackface | | Scottish Blackface | |
|---|---|---|---|---|
| | **Rams n = 50** | **Castrates n = 47** | **Rams n = 47** | **Castrates n = 49** |
| Animal smell/ farm smell | 18 | 0 | 9 | 4 |
| Woolly Aroma | 14 | 6 | 4 | 4 |
| Rancid Aroma | 6 | 2 | 4 | 0 |
| Manure/Faecal Aroma | 10 | 2 | 4 | 2 |
| Off- Flavours | 8 | 0 | 4 | 0 |
| Rancid Flavour | 18 | 4 | 11 | 4 |
| Farmyard Flavour | 22 | 13 | 9 | 6 |
| **Total[1]** | **42** | **21** | **26** | **12** |

[1]Percentage of animals with one or more "undesirable" attribute.

A higher number of rams (34% overall) than castrates (17% overall) and T×SB (32% overall) than SB (19% overall) lambs exceeded the cut-off for the seven attributes that were tested. It is also notable that some castrates were among the animals exceeding the cut-off, suggesting that potential off-flavours and aromas in lamb samples are not confined to rams. A similar point can be made with respect to the two breeds.

## How do these results compare with studies from other countries?

In a British study, carcasses from entire males were heavier but had significantly (23%) less fat, and the taste panel failed to identify any difference in flavour, texture or overall acceptability (Dransfield et al., 1990). In the same study consumer ratings of leg roasts for aroma and eating quality showed that the proportion of households that rated the meat as having a "very much better than usual" aroma and eating quality was considerably higher for legs from the entire males (33% and 34%, respectively) than for those from castrates (14% and 19%, respectively). It is clear from that study that entire male lambs yield meat that satisfied consumers at least as well as that from castrates.

In a New Zealand study (Young et al., 2006), entire males and castrates were evaluated over a wide age range of 4 to 24 months. There was no difference in meat toughness up to age 10 months, but at 13 months the meat from entire males was tougher. The taste panel detected no differences in sensory evaluations up to 13 months of age but there was evidence that some of the sensory attributes diverged when the animals were between 15 months and two years. The authors concluded that the "sex category and age effects give some credence to the idea that older rams are 'sheepier' but that up to 668 days on pasture the effect on flavour is negligible". The vast majority of Irish lamb is slaughtered before lambs reach 12 months of age.

A large-scale Canadian study involving consumers tested at 31 supermarkets provides clear evidence, based on visual evaluation, on this (Jeremiah et al, 2000). The author reported that "respondents demonstrated an obvious aversion to fatness" when asked to evaluate an array of packages containing lamb chops. Chops from entire males slaughtered at between 40.5 and 49.5kg live weight were the only exception to this general finding as only 30% were rejected as being too fat compared with 84% for those from equivalent castrates.

Hanrahan (2010) concluded following a review of the available literature at that time, where lambs are reared on an all grass diet and slaughtered by the end of the grazing season, leaving male lambs entire has no negative effect on meat quality, whether assessment is laboratory based or through consumer testing. These conclusions are consistent with those of Purchas and Schreurs (2009), who reviewed evidence on this matter from a New Zealand perspective.

Cumulatively, the above studies failed to find major gender-related effects on the eating quality of lamb. The current Irish studies confirm the well-established production and efficiency benefits associated with rams and that while there is a greater likelihood of obtaining a "problematic" sample with meat from ram lambs, only a proportion of rams produce such "problematic" samples and that castration does not eliminate this it.

## Should Irish sheep producers castrate lambs or not?

There are undisputed efficiency advantages of leaving male lambs entire which result in these lambs being ready for slaughter 10-14 days earlier than wether lambs. Also, ram lambs are leaner which, from a consumer point of view, is desirable. However, rams lambs reach the desired target fat score of 3 at a heavier weight compared to wethers. Frequently, this is commented on as rams lambs "being slower and more difficult to finish" to reach factory fit body condition. The kill-out % for ram lambs is 1 to 2.5 percentage points lower for rams depending on lamb age, diet and breed with the greatest difference observed with horned breeds. From autumn onwards rams and ewe lambs must be separated, otherwise rams lambs will spend significant energy following female lambs and there is a risk of pregnancy with female lambs. The current Teagasc-UCD studies have confirmed the production benefits from leaving lambs entire and recorded a low to modest incidence of meat samples from ram lambs with undesirable sensory attributes. However, castration did not eliminate the problem of getting of undesirable sensory attributes meat samples although the incidence was lower in meat from castrated lambs. This would also suggest that so called "ram taint" issues might be due to other factors such as slaughter age, diet, consumption habits and culinary methods, unrelated to whether lambs are entire or castrated and is certainly worthy of further investigation.

While castration reduces but does not eliminate the risk of obtaining "problematic" lamb meat samples the consequences of castration are reduced production efficiency as well as the increased likelihood of higher fatness which is likely to occur with smaller breeds such as Scottish Blackface, particularly as producer strive for heavier lamb carcass weights. Whether producers castrate lambs or not will depend on their production system, time of lamb finishing, flock size, ability to separate ewe and ram lambs in the autumn and as well as the signal from the market place. The trend toward non-castration has become well established in recent years. If processors require more castrate lambs its probable that they will have to reward producers by paying a premium for such lambs.

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# Beware – Don't get hit with a hidden disease! – the truth behind OPA, Johnes & CLA and how to protect your flock

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## Take Home Messages

- Don't have your head in the sand about these diseases – know your own flock status
- Talk about these diseases – especially with your vets and the people you buy sheep from
- Check your flock security and don't unwittingly buy in someone else's problem

## Introduction

An 'iceberg disease' is a term used by the medical profession to describe a disease which has a large number of undiagnosed cases so that what is seen clinically is a small representation of the total. In the sheep industry, it is a phrase that is generally used to describe diseases that are insidious, production-limiting, slow in onset and diagnostically challenging. The following have all been described as 'iceberg diseases' of sheep in UK: OPA (Jaagsiekte), Ovine Johnes Disease, CLA (Caseous Lymphadenitis), Maedi Visna (MV), Border Disease, TB, and Scrapie, of which the first three are considered in detail in this paper. All these diseases (except for Border Disease) are notifiable in Ireland, to the Department of Agriculture, Food and the Marine.

## Maedi Visna

Is currently not thought to be present in Ireland, however its prevalence is increasing in UK so some brief information about it is included here. In Maedi we see respiratory signs & heavy lungs in older sheep as well as mastitis. In the Visna form of the disease, we see progressive nervous signs (classically dragging a hind leg). MV is caused by a lentivirus (a non-oncogenic RNA retrovirus) and spread by oro-nasal infection (like a common cold). The lentivirus becomes latent in the genome of white blood cells so it evades the host immune system. In the UK the control of MV has been by an accreditation scheme though there has been an increase in the numbers of cases throughout the country in recent years. It is important that Irish producers are aware of the disease and the need to strictly comply with importation requirements to keep it out of Ireland.

Details of Ovine Pulmonary Adenocarcinoma caused by Jaagsiekte sheep retrovirus (JSRV), Ovine Johnes disease caused by Mycobacterium avium paratuberculosis and Caseous Lymphadenitis caused by Corynebacterium pseudotuberculosis are summaries in Tables 1, 2 and 3, respectively.

**Table 1.** Ovine Pulmonary Adenocarcinoma caused by Jaagsiekte sheep retrovirus (JSRV)

| | |
|---|---|
| ***Symptoms*** | Increased respiratory rate with a soft cough. Sheep remain bright with a good appetite unless a secondary bacterial pneumonia develops (this becomes more common in affected flocks). Later in disease, lots of clear frothy fluid flows from nostrils when head down. |
| ***Survival*** | Jaagsiekte sheep retrovirus (JSRV) will survive several weeks in the environment |
| ***Spread*** | By respiratory aerosol & via contaminated troughs & water. Transmitted via milk & colostrum. Uterine spread low if at all. |
| ***Pathology*** | Oronasal infection leads to a cancer in the lung with lots of white foaming fluid. Incubation is generally 3 years long but it can be seen from 2 mths to 11 yrs old |
| ***Diagnosis*** | No immune response so no blood serology possible. PCR is possible in the respiratory system & peripheral blood lymphocytes but it is not commercially available and it has a low sensitivity as virus levels fluctuate. Thoracic ultrasound can used to identify infected animals if the lesions are greater than 2cm and on the surface of the lung. |

| | |
|---|---|
| ***Control options*** | 1. Identify & cull infected ewes and their offspring.<br>2. House & manage in single age groups – especially keep young sheep separate from adults<br>3. Reduce close contact – consider housing, stocking density, trough feeding.<br>4. Snatch lambing & rear artificially – shown to be successful in a German case study |
| ***Context*** | Prevalence of OPA in Ireland appears to be similar to the UK with JSRV-positive sheep identified in the counties of Donegal, Kerry, Kilkenny, Offaly, Tipperary, Waterford and Wicklow, often clustered within the same flocks. Nearly 2000 adult sheep were investigated and 1.6% were found to be infected with JSRV and 0.5% with OPA[1] |

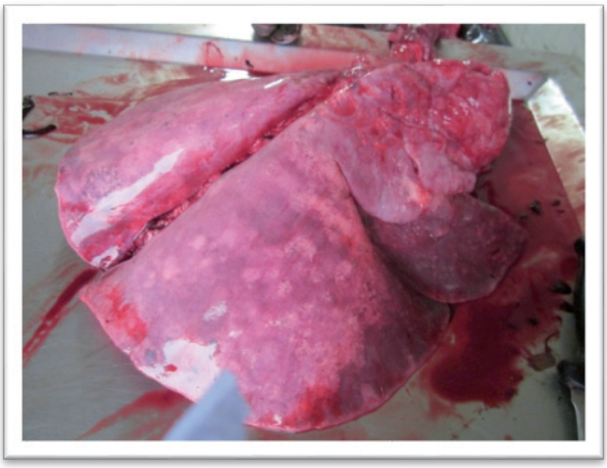

**Fig 1 & 2** Sheep lungs with large OPA tumours

**Table 2.** Ovine Johnes Disease caused by Mycobacterium avium paratuberculosis

| | |
|---|---|
| ***Symptoms*** | Sheep get very thin and emaciated but do not scour like cattle with Johnes do. Increase in culling rates due to poor condition |
| ***Survival*** | 9 months in water, 11 months in slurry, 48 months in soil |
| ***Spread*** | Ingested orally. Invades & multiplies in small intestine lymphatic tissue & mesenteric lymph nodes. Shed in faeces of clinical & pre-clinical cases. Found in milk & placenta of clinical cases. Any age is susceptible but especially if young. |
| ***Pathology*** | 70% of cases are multibacillary – lots acid-fast bacilli in mucosal macrophages. Villous fusion, gut thickening, humoral antibody response<br>30% of cases are paucibacillary –few or no bacilli. Cell-mediated response but little gut change or antibody response. |
| ***Diagnosis*** | ELISA test detects 3-6 months post infection or AGIDT test – both have good specificity but poor sensitivity (as low as 50% for paucibacillary cases) – so lots of false-negatives. PCR on faeces works well and can pool faeces from up to 10 animals Most reliable diagnosis by post-mortem histopathology of small intestine and mesenteric lymph nodes |
| ***Control options*** | 1. Limit spread by early culling of clinical cases & remove offspring.<br>2. Test & cull. Blood testing, faecal culture or PCR two to four times a year. Expensive<br>3. Management – limit lambing in wetter areas. Keep young stock away from adults.<br>Use automatic water feeders & strict hygiene inside. |
| ***Vaccine*** | Gudair (Virbac) is now available in UK - suggest vaccinated everything below one year old & all bought-ins. Vaccinates will still shed Johnes in faeces & have detectable Ab so not suitable for export. Review of several papers indicates: Vaccination reduces culture +ve sheep >70%, lesions by 96%, clinical cases by >50% |

**Fig 3.** Typical pigmentation and thickening of the small intestine in a ewe with Ovine Johnes Disease

**Table 3.** CLA - Caseous lymphadenitis caused by Corynebacterium pseudotuberculosis

| | |
|---|---|
| ***Symptoms*** | Discrete swellings around the head and neck which can burst to discharge a thick pus |
| ***Survival*** | This bacterium with a lipid coat survives for 8months in soil, 24h in dip |
| ***Spread*** | Incubation is 6 weeks - 4months as it spreads from infected wound to the draining lymph node. Spreads by close contact – at clipping, dipping, especiallyshowering and post-dipping. Also respiratory spread in droplets. Very low prevalence in sheep up to 1 year old and little spread to pre-weaned lambs |
| ***Diagnosis*** | Difficult to diagnose (especially once the abscess becomes walled off)<br>Blood test ELISA (Sensitivity=87%, Specificity= 99%) which means a few false positives & lots of false negatives. Confirm a positive by Western Blot test.<br>SAC Monitoring Scheme tested pre-sale (Isolate for 12 weeks & then required 2 negative ELISA taken 6 weeks apart) |
| ***Control options*** | Restrict movement & contact with infected flock. Avoid any nose-to-nose contacts at sale. Check flock regularly. Handle young sheep first. Keep ram lambs separate. Investigate suspicious cases. Avoid puncturing abscesses unnecessarily.<br>Don't handle closely in dusty yards. Quarantine infected premises for a long time. |
| ***Vaccine*** | Glanvac available from Zoetis Australia – VMD reports that approximately 25000 doses are imported into UK each year & it is estimated that this is half the total imported Research at Moredun has developed a DIVA vaccine but not commercially available. |

**Fig. 4.** CLA abscess seen on post mortem (Left) & **Fig. 5** Discharging abscess in the parotid area of a sheep (photo Phillipa Page) (right)

## Border Disease

Is caused by a pestivirus with very similar epidemiology to BVD in cattle. It is transmitted via the oro-nasal route with the persistently infected (PI) animals as important reservoirs of infection in a flock. Pregnant ewes are at most risk as they either abort or produce PI lambs that are either weak, normal or 'hairy shakers' that continually shed virus. Border Disease was considered fairly important in Ireland with a prevalence of 5.6% of individuals and 46% of flocks though many of these were found to actually be BVD virus and suggested to be a 'spill-over' from cattle[2]. Hopefully these figures may have reduced as a result of the cattle BVD eradication scheme.

## On all farms we need to protect healthy stock by the following measures:

- Know the status of the farm and the presence of disease before it becomes widespread (there are blood tests for OJD, CLA, BD and MV, – but note that it requires careful communication between the vet and farmer and an understanding of the limitations of the test, which have less than perfect specificities & sensitivities so there will be false positives and false negatives.
- Monitor disease by *post mortem* examination of fallen stock & cull ewes (especially relevant for OJD and OPA).
- Examine flock regularly for CLA – remember to check young-stock first!
- Vaccinate where necessary & if possible against either OJD or CLA.
- Buy clean replacements - where possible.

## What can we do about the risk on a national level?

- Consider all sheep movements between farms, mixing of stock and markets.
  - Particularly consider the stratification of the industry – the risk of commercial ewes being bred on hill farms and moving to lowland farms and the risk of terminal sires moving back up the hill and jeopardising the top of the stratification.
- Raise awareness – buyers beware and asking the right questions of vendors.
- Promote accreditation, monitoring, consideration of health status – but taking into consideration all issues raised by the diagnostic challenges.

## What can we do on an infected farm?

- Remove infected sheep (and their offspring) – this needs rapid accurate identification and depends on an effective test in live animal. This is a challenge with OPA in particular.
- Restock with clean sheep - difficult to ensure due to poor sensitivity of test in live animal (- aim for flocks where some monitoring has occurred for CLA and OJD or an otherwise reliable source)
  - Requires buyers demanding health status
  - Requires sellers receiving a premium for high health status sheep.

- **Reduce transmission**
  - Consider mother to offspring spread – snatch lambs and rear separately may be suitable to some degree for OPA, OJD and MV but not always practical on farm
  - Consider horizontal spread – avoid close housing, trough feeding, high stocking density. Keep young-stock away from adults
  - Consider fomites – especially shearing equipment, personnel, clothing etc for CLA; clean troughs etc for OPA.
  - Consider survivability outside sheep to assess risk of environmental contamination

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