Dry and transition cow nutrition for the grazing Irish dairy herd

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Introduction

The period directly before and directly after calving is a critical period for the health and welfare of the dairy cow (Mulligan and Doherty, 2008). The issues that might arise at this time can also impact on herd profitability through an extended influence on lameness (Bicalho et al., 2009), herd fertility outcomes (Walsh et al., 2011), herd somatic cell count and mastitis (O'Rourke, 2009). In Ireland, the typical scenario for cows in the transition period is a grass silage-based dry cow diet and a grazing early lactation diet. The following paper will emphasise some of the key issues for these diet types and the production system in general related to nutritional and metabolic status in the dairy cow. The observations contained within this paper are based on relevant published research and the herd cases referred to the Dairy Herd Health Group, School of Veterinary Medicine, University College Dublin. This paper will concentrate on nutrition *per-se*. However, on many farms, husbandry factors are very important for nutritional status. Issues such as inadequate access to feed and water, insufficient comfortable cubicle beds, and moving cows to the home farm close to calving, are much too common on Irish farms. These issues must be addressed for an optimal nutritional status.

The dry cow diet

Provision of an appropriate energy allowance for dry cows

Dry cows (600kg) require 6.4, 7.1 and 8.1 UFL per day when housed 3 months prior to, 2 months prior to and in the last month prior to calving, respectively. These requirements assume that cows are dried off with an appropriate BCS (Table 1). Grass silages are extremely variable in their major nutritional qualities. A very comprehensive study of pit silages carried out in Northern Ireland (Steen et al., 1998) reported huge variation in grass silage quality (see Table 2). When consumed at a typical consumption level by dry cows (1.8

to 2.0% of body weight; Butler et al., 2011), some grass silages will provide an insufficient amount of energy for pregnant dry cows (depending on BCS) and some will provide too-much energy.

Table 1. Dry cow diet: Daily UFL and PDI recommendations (600 kg cow housed; BCS on target)

Months pre-calving	**UFL/day**	**g of PDI/day**
3	6.4	475
2	7.1	535
1	8.1	605

Add 0.35 UFL and 25 g of PDI per 50 kg increase in weight.

Dietary major minerals and DCAD

Calcium	0.45% (none added unless DCAD is -100 to -200 meq/kg DM)
Phosphorous	0.3% of the diet DM
Magnesium	0.4% of the diet DM
Potassium	≤ 1.8% of diet DM (many silages will be higher)
DCAD	0 to 150 meq/kg of DM (many silages will be higher)

Supplemental daily vitamin allowances

Vitamin E	1,200 IU
Vitamin D	25,000 IU
Vitamin A	75,000 IU (NRC daily allowance is 100,000 IU)

Supplemental daily trace element allowances[1]

	Normal concentration in forage	**Deficiency in forage**
Copper*	150	450
Se	3	5
Iodine	12	60
Zinc	335	750
Manganese	350	415
Cobalt	5	10

All values are for added trace elements in elemental form in mg/cow/day.
[1]Source: Control of Mineral Imbalances in Cattle and Sheep (Rogers and Gately, 1992; 2000)
*Deficiency recommendation to be used where Mo > 2.0 mg/kg of silage DM.
Maximum permitted levels in the EU are 35 mg/ kg DM of Copper, 0.5 mg/kg DM of Selenium and 5 mg/kg DM of Iodine.

If grass silage quality is very poor, cows may lose BCS in the dry period. Furthermore, in years of low milk price and or poor grazing conditions in the autumn, cows may dry-off with a low BCS. In this case, care must be taken to ensure that cows end up with an appropriate BCS of 3.0 to 3.25 at calving (Roche, et al., 2009; Table 3). Thin cows have been proven to have a significantly increased risk of lameness (Bicalho et al., 2009), uterine health and retained foetal membranes issues (Heuer et al., 1999, Hoedemaker et al., 2009). If the low BCS persists to the breeding season, low fertility performance will result (Buckley et al., 2003).

Table 2. Typical grass silage feeding value variation

	Mean	**Minimum**	**Maximum**
Dry matter (%)	21.9	15.5	41.3
Crude Protein (g/kg DM)	130.0	80.0	210.0
Ammonia N (% of total N)	12.3	4.5	38.5
Lactic acid (g/kg DM)	66.0	0	144.0
Acetic acid (g/kg DM)	29.0	4.0	63.0
Butyric acid (g/kg DM)	7.0	0	32.0
pH	4.1	3.5	5.5
Organic matter digestibility (%)	71.0	56.0	83.0
Voluntary intake by beef cattle (kg/day)	6.6	4.3	10.9

Steen et al., (1999)

Typical mineral and trace element variation in Irish grass silages

	Mean	**Minimum**	**Maximum**
Calcium (% of DM)	0.69	0.25	1.61
Phosphorous (% of DM)	0.31	0.10	0.72
Magnesium (% of DM)	0.18	0.08	0.43
Potassium (% of DM)	2.35	0.63	5.59
Sodium (% of DM)	0.36	0.04	1.03
Sulphur (% of DM)	0.31	0.08	0.98
Copper (mg/kg DM)	10.4	2.8	32.0
Selenium (mg/kg DM)	0.09	0.02	2.3
Iodine (mg/kg DM)	0.27	0.04	0.98
Zinc (mg/kg DM)	29.7	10.0	94.0
Manganese (mg/kg DM)	103.5	2.0	477.0

Rogers and Murphy (2000)

To increase BCS by 1 unit will require a feed allowance above those suggested in Table 1 of 200 UFL over the length of the dry period. If the herd is thin in late lactation (e.g., 50% of cows at BCS 2.5 and less), the option exists to dry off cows early, especially in years of low milk price. If dried off early (e.g., a 12 week dry period), cows fed average quality grass silage (68 DMD) should have an increase in BCS of approximately 0.5 units before calving. If the low BCS is only noticed at dry off, 8 weeks pre-calving, ad-libitum good quality grass silage is enough to increase BCS by 0.30 units approximately (grass silage quality 72 DMD). With average and low quality grass silage and where BCS is very low at dry off (8 weeks pre-calving) concentrate supplementation will be required for dry cows. Table 4 shows the concentrate feeding levels required by dry cows of differing BCS fed different quality grass silages to achieve an appropriate BCS at calving.

Table 3. Target BCS for dairy cattle at different points of the lactation cycle

BCS at Drying off	2.75-3.0
BCS at calving	3.0-3.25
BCS at 42 days in milk	2.75 minimum
BCS at breeding	2.75 minimum
BCS in late lactation	2.75-3.0
90% of the herd should meet these targets	

The group of cows that calve from March on are most at risk from over-conditioning as this group often have a prolonged dry period. It has been proven that when dairy cows calve down in an over-conditioned state (BCS 4.0, scale 1-5) they have a higher level of BCS loss post-calving, a compromised metabolic state, and a reduced feed intake in early-lactation (Alibrahim et al., 2010). Furthermore, there is a good deal of data in the literature showing that feeding excessive amounts of energy in the far-off dry period (e.g., the first month after dry-off) in particular, has a negative impact on metabolic status, energy consumption early in lactation and reproductive outcomes (Cardoso et al., 2013). Thus there is nothing to be gained from a cow health perspective from over-feeding energy in the dry cow diet. Therefore, every effort should be made to feed appropriate energy allowances at this time.

Having cows in the correct BCS at all stages of the lactation cycle should always be a priority. The most important aspect of dry cow nutrition is to ensure the correct calving BCS for at least 90% of the herd. Thus, if BCS corrections are required in late lactation or at dry off, a nutritional strategy should be put in place to ensure an appropriate energy allowance is offered. The recommended BCS for dairy cows at each point of the lactation cycle is depicted in Table 3. These are the BCS scores advocated by the Dairy Herd Health Group at UCD. They are largely consistent with other recommendations for dairy cows using the 1-5 BCS scale.

Type of energy for dry cows

There are many theories on why non-structural carbohydrate should be fed to late pregnant dry cows such as developing rumen papillae, acclimatizing rumen microbes and avoiding fatty liver. It is also interesting to note that NRC (2001) advocates a 70% increase in energy density in the close-up dry cow diet. There is not a lot of research evaluating the requirement for these strategies in grass silage-fed dry cows going to grass post-calving. However, data from Burke et al. (2010) for New Zealand dairy cows indicates that feeding non-fibrous carbohydrate in the late pregnant dairy cow diet had no effect on reproduction in grazing dairy cows. In Irish data, McNamara et al. (2002) reported prolonged negative energy balance in early lactation as a result of feeding 3kg of concentrate for 4 weeks pre-calving. It is interesting that a large on-farm study recently completed in Northern Ireland did not find any benefit on milk production, fertility or culling as a result of supplementing concentrates for the final three weeks pre-calving for cows with BCS in the desired range. However, for thin cows, supplementing concentrates in the final 3 weeks pre-calving reduced the culling rate at 60-days post-calving (AgriSearch, 2010). Thus the requirement for concentrate in the dry cow diet of most Irish cows (ca 5000litres of milk; 400kg fat and protein) should be driven primarily by concerns about BCS and silage quality. The requirement for the development of rumen papillae and to acclimatize rumen microbes for dry cows coming off a grass silage-based diet and receiving 4kg or less of concentrate feed in a grazing scenario, is unlikely to be significant, if BCS is on target. For cows that will be fed 8kg of concentrate or more in early lactation, a conservative approach in keeping with the normal digestive physiology of the cow and international research (McCarthy et al., 2015) would be to feed 1kg of starch in the last 2 weeks pre-calving. This could be 2kg of a dry cow nut, 2kg of barley or 10kg of maize silage or whole crop wheat silage (as fed). This concentrate (starch) feeding at this time may be of increased importance for thin cows.

Table 4. Recommended concentrate allowance for 12 weeks and 8 weeks dry periods with grass silage quality 64 to 72 DMD, and different BCS at dry off.

12 weeks dry	3 months pre-calving	2 months pre-calving	last month
BCS 3.0 to 3.25			
64 DMD	RE	RE	0.4
68 DMD	RE	RE	AL
72 DMD	RE	RE	AL
BCS 2.5 to 2.75			
64 DMD	AL	0.6	1.8
68 DMD	RE	AL	1.2
72 DMD	RE	RE	0.6
BCS 2.0 to 2.25			
64 DMD	1	1.8	2.9
68 DMD	0.4	1.2	2.3
72 DMD	AL	0.7	1.8
8 Weeks dry		**2 months pre-calving**	**last month**
BCS 3.0 to 3.25			
64 DMD		RE	0.4
68 DMD		RE	AL
72 DMD		RE	AL
BCS 2.5 to 2.75			
64 DMD		1.2	2.3
68 DMD		0.7	1.8
72 DMD		AL	1.2
BCS 2.0 to 2.25			
64 DMD		3.0	4.1
68 DMD		2.4	3.6
72 DMD		1.9	3.0

RE, Restricted energy advised, AL, Ad-libitum feeding of silage advised.

Dry matter intake assumed at 1.8% of body weight. Assumed 200 UFL required for 1 unit increase in BCS. Assumed concentrate is 0.9UFL/kg as fed. Appropriate supplementation for major minerals, trace elements, protein and vitamins should always be practised.

Provision of appropriate protein allowance for dry cows

The requirement for protein (PDI) in the last 3 months of the pregnancy for dry cows is approximately 475, 535 and 605g/d for a 600 kg cow (O'Mara, 1996; Wolter and Ponter, 2012; Table 1). In most cases, with grass silage only diets this amount of PDI will be supplied. However difficulty arises if either the PDIN or the PDIE value of grass silage is less than 60g/kg of DM. Difficulties with PDI provision will also arise where straw or low protein forages might be included in the diet of the dry cow. It is important that silage is analysed to determine the need for supplementary protein. Although other feeding standards organisations (NRC, 2001) recommend higher protein allowances than the PDI allowances, research work carried out in Ireland found no benefit to supplementing high levels of protein to dry cows fed grass silage based diets. However, for diets based on grass silage and straw fed in restricted amounts, improvements in milk protein concentration were noted in early lactation following supplementary protein feeding in the dry period (Murphy, 1999). Thus PDI balances should be calculated based on the farm specific forage(s) used in the dry cow diet, it is likely that supplementary protein will be required for almost all dry cow diets containing straw, low protein forages or low PDI grass silages. It is certainly noteworthy that the feeding of straw to dry cows has become more popular and that a greater proportion of grass silages are lower in protein than was the case 10 to 15 years ago.

Major minerals for dry cows

The most important issue to be considered with regard to the major mineral nutrition of the dry cow is to establish a good basis for the control of milk fever and subclinical hypocalcaemia. Research with grazing cows in other regions has demonstrated that even where milk fever is relatively well controlled (clinical milk fever recorded in ca. 5% of cows at calving) that approximately 33% of the cows may experience subclinical hypocalcaemia (Roche, 2003). It is important to note that all cow types have a significant challenge to their calcium status at calving. Interestingly, recent work published internationally has indicated that 25% of first lactation cows may experience subclinical hypocalcaemia (Reinhardt et al., 2011). Subclinical hypocalcaemia has been linked to reduced immune system competence, and the UCD Dairy Herd Health Group has come across transition cow issues related solely to subclinical hypocalcaemia.

One of the most important aspects of maintaining control over milk fever and subclinical hypocalcaemia in an Irish context is to maintain BCS within the desired range at calving. It has been shown that both high BCS and low BCS at calving increase the risk of milk fever. The magnesium content of the diet is also critical for the provision of an adequate calcium status. It has been reported that magnesium concentration is the single most important dietary factor with regard to milk fever control (Lean, 2006). Based on typical magnesium concentrations found in Irish grass silage samples (Rogers and Murphy, 2000; Kavanagh et al., 2011), 20-25g of magnesium will be required from the dry cow mineral. For grass silages with below average magnesium status, the provision of 30g of magnesium per cow per day in the dry period is justified. The next major mineral of importance in the dry cow diet is potassium. High levels of potassium in the dry cow diet induce metabolic alkalosis. Once this metabolic state is established it becomes more difficult for the cow to mobilise bone calcium which she must do to maintain an adequate level of calcium in the blood immediately after calving. High levels of potassium also tie up magnesium in the rumen, thus having the potential to negatively affect calcium status through two separate mechanisms. The average potassium concentration in Irish grass silages is typically 1.8% to 2.4% (Rogers and Murphy, 2000; Kavanagh et al., 2011). However, there is a wide variation in the potassium content of Irish grass silages. Grass silages with a potassium concentration above 2.75% are particularly problematic and often cause problems in dry cow diets with clinical milk fever or the conditions which arise from subclinical hypocalcaemia (retained placenta and uterine infection). Rogers and Murphy (2000) reported that 11% of Irish grass-silages have a potassium concentration of more than 3.1%. In herds where this type of grass-silage is the sole dry cow feed, a carefully planned milk fever control strategy is warranted. Combining these grass silages with straw may well be appropriate, but correction for energy and protein allowance may be required depending on grass silage quality and cow BCS. The recommended phosphorous content of dry cow diets is 0.3% of the DM (NRC, 2001, Lean el al., 2006). In many cases, Irish grass silages will supply sufficient amounts of phosphorous. However, in cases where silages have significantly lower than 0.3% phosphorous, then supplementation with 5 to 10g of phosphorous daily from the dry cow supplements may well be warranted.

Trace elements for dry cows

International research continues to demonstrate the important roles that trace elements play in transition cow health and milk production (Bicalho et al., 2014; 2009; Cope et al., 2009).

Herd cases of trace element deficiency also arise relatively frequently in Ireland (UCD Dairy Herd Health Group) without any systematic recording or reporting. Rogers and Murphy (2000) reported that within Irish grass silages 63% are low in copper, 43% are very low in iodine, 69% are very low in selenium and 29% are low in zinc. Despite this fact there are cases where farmers decide not to supplement grass silage-based diets with minerals and trace elements in the dry period. This strategy cannot be advised and farmers should ensure that dry cows are supplemented with major minerals, trace elements and vitamins during the dry period. Trace element and mineral feeding should be based on a farm specific forage analysis as some grasses and grass silages have high concentrations of certain trace elements and toxicity may arise.

The start of lactation for the transition cow

In the typical seasonal breeding spring-calving Irish dairy herd achieving good fertility is an absolute priority. It has been very well established that negative energy balance and poor metabolic status have negative consequences for fertility outcomes (Walsh et al., 2011; Leroy et al., 2008). Therefore, we must aim to limit the severity and duration of the negative energy balance experienced in the first weeks after calving and to provide a positive metabolic status to enable good fertility. We do of course need to be mindful that for financial sustainability of the farm business, this goal needs to be achieved in the most cost efficient manner possible.

Provision of sufficient energy in early lactation

In Ireland the Irish net energy system for cattle and sheep is used to provide appropriate energy allowances for dairy cows of different types and production levels (O’Mara, 1996). For a typical 600kg grazing dairy cow, 6UFL per day are required for maintenance and approximately 0.42 – 0.45UFL are required per kg of milk produced. In addition, the system calculates an extra requirement arising from reduced digestive efficiency when forage and concentrates are combined in diets, or when net energy intake rises to the high levels expected for lactating cows (O’Mara, 1996). For typical grazing dairy cows producing 5,000 litres of milk per lactation (370 to 400kg of fat and protein), a peak daily requirement of 17.5 to 18 UFL is likely to be a sufficient energy allowance at peak milk production. This UFL provision is possible with a mostly grazing diet. For a 600kg cow producing 26kg of milk at 3.8% fat, an allowance of 2.3kg of concentrates (as fed) if provided with a grass dry matter intake of 15.0kg per day would meet 100% of the UFL requirements of this animal (Table 5). On the other hand, a 600kg cow producing 34kg of milk at 3.8% fat would require 6.7kg of the same concentrate where grass intake is 15.0kg of dry matter. Where grass dry matter intake is restricted to 12kg of DM, higher concentrate allowances will be required to provide 100% of energy requirements. In particular, the requirement for UFL from supplements is high when cows are fed grass-silage by night and grazed grass by day early in the grazing season.

For grazing herds, farmers should be encouraged to meet as much of the UFL requirement as they can from grazed grass, but they should also be encouraged to feed energy to 100% of UFL requirement to prevent BCS loss and poor metabolic status in early lactation. It should be remembered that for cows calving down with a BCS of 3.0 or greater, where BCS loss is greater than 0.5 units in early lactation then a reduction in 6 week pregnancy rate of approximately 8 percentage units could be expected in comparison to cows losing 0 and 0.25 units of BCS in early lactation (Buckley et al., 2003). It should be noted that feeding cows to 90% of UFL requirement instead of 100% on a continuous basis, will result in approximately 1 unit of BCS loss in 3 months. Irish research has shown that BCS levels below 2.75 in the breeding season will reduce fertility performance (Buckley et al., 2003). Appropriate concentrate allowances for a standard grazing cow with different grass dry matter intake levels and for grass silage / grazing diets are outlined in Table 5.

Strategies used to alter metabolic status in early lactation

Diets that are mostly based on grazed-grass will contain a high energy density, which is very beneficial to the early lactation cow. However, high quality perennial ryegrass-based swards are likely to contain a high crude protein and PDIN concentration, which will increase blood urea nitrogen. Furthermore high protein diets would seem to partition nutrients towards milk production at the expense of energy balance (Whelan et al., 2014). In recent research carried out at UCD, Whelan et al. (2012) demonstrated that concentrate type had a significant positive impact on metabolic status in early lactation dairy cows at grass. In this study, grazing cows fed 6kg of a 14% protein compound based on maize grain had significantly reduced blood urea nitrogen and betahydroxybutyrate in comparison to cows fed 6kg of an 18% protein compound based on barley. It was very interesting that the yield of fat and protein for cows fed the 14% protein compound based on maize was not significantly different to that of the cows fed the 18% protein compound based on barley. In the study of Whelan et al., (2012) it was not possible to investigate the impact of this improved metabolic status on reproductive outcomes. However, in similar New Zealand research, supplementation of cows fed grazed and ensiled perennial ryegrass with non-structural carbohydrate improved metabolic status and reproductive outcomes (Burke et al., 2010). In this study feeding a corn and barley-based concentrate at 5kg dry matter per day increased dietary non-structural carbohydrate and reduced dietary crude protein concentration. Cows fed the high non-structural-carbohydrate supplement had significantly shorter post-partum anovulatory interval and significantly improved six week pregnancy rate.

The fresh cow in the grazing herd

Dairy cows often have the most severe underfeeding of the year in the first and second week after calving. Although the milk yield is low in these weeks, the very low feed consumption at this time results in the greatest energy deficit. Generally speaking the optimal husbandry for the cow at this time would be to ensure maximal dry matter intake of high energy well balanced diets. Many cows calving in January and early February will have a number of weeks lactating indoors (depending on grazing conditions). In these cases, it is critical that high quality grass silage is used (minimum 70 DMD) and that diets are fortified with appropriate levels of concentrate for the yield and milk constituents of the cow. The use of poor quality grass silage will require a high level of concentrate supplementation during this period. Where cows can go to grass immediately after calving, concentrate allowances should be calculated based on the total UFL requirement of the cow and the gap that exists when you have estimated the UFL supplied from the grass alone. Where grass dry matter intake is maintained low to manage sward quality, it is important to continue to supply the UFL requirements of the cow. For higher milk output cows (7000-7500 litres; 550-575kg of fat and protein), research at UCD Lyons Farm has demonstrated that a high energy TMR type diet fed indoors for the first three weeks post-calving improved metabolic status in early lactation and grass dry matter intake at six weeks post-calving (Alibrahim et al., 2013). This strategy may suit a certain cohort of Irish farms. However, for strictly grazing low input farms with cows producing ca 5,000 litres of milk (370 to 400kg of fat and protein), the priority should be on meeting the energy requirements with a mainly grazed-grass diet and the required level of supplements to bridge the UFL gap.

Table 5. Recommended supplementary concentrate allowance to supply 100% of UFL requirement in early lactation for cows of differing milk yield with varying grazed grass and silage intake.

	Milk yield (kg/d)								
	18	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**
[1]6 kg Grass DM 6 kg 64 DMD	4.0	4.9	5.9	6.9	7.9	8.9	9.9	10.9	11.9
6 kg Grass DM 6 kg 70 DMD	3.5	4.4	5.4	6.4	7.4	8.4	9.4	10.4	11.4
6 kg Grass DM 6 kg 74 DMD	3.2	4.1	5.1	6.1	7.1	8.1	9.1	10.1	11.1
Grass dry matter intake (kg/d)									
12	1.9	2.8	3.8	5.0	6.0	7.0	8.0	9.0	10.0
13	0.8	1.7	2.7	3.6	4.9	5.9	6.9	7.9	8.9
14	0.0	0.6	1.5	2.5	3.4	4.8	5.8	6.8	7.8
15	0.0	0.0	0.4	1.4	2.3	3.7	4.7	5.7	6.7
16	0.0	0.0	0.0	0.3	1.2	2.2	3.1	4.6	5.6
17	0.0	0.0	0.0	0.0	0.1	1.1	2.0	3.0	3.9
18	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	2.8

[1], Concentrate allowance for 6 kg of grass dry matter and 6kg of grass silage dry matter (64-74 DMD)

Assumptions: Cow weight is 600kg, milk fat = 3.8%, cow activity grazing assumed in all circumstances.

Grass assumed to have 1.0 UFL/ kg of DM.

Total forage intake assumed at 12 kg of DM when cows are grazing by day only in early spring.

Energy requirements in underlined figures taken from Table 3.1 O’Mara, 1996 (30% concentrate in the diet) plus an allowance of 0.5 UFL/day for activity at grazing.

Grass silage of 64, 70 and 74 DMD assumed to have 0.71, 0.79 and 0.84 UFL/kg DM.

This table contains concentrate allowances to supply UFL only. Supplementation may be warranted for protein, major minerals, trace elements and vitamins.

Assumed concentrate is 0.9UFL/kg as fed.

Major minerals and trace elements for milking cow

The main problems encountered by the UCD Dairy Herd Health Group in this area are phosphorous, copper and iodine deficiency. A 2013 study on Irish grazing farms indicated that on average grass supplied only 85%, 73%, 52%, 50% and 38% of lactating cow requirements for phosphorous, copper, iodine, zinc and selenium (Curran and Butler, 2015). For copper, appropriate supplementation seems to overcome the deficiency with many well supplemented milking herds showing no signs of copper deficiency on pasture where young stock have deficiency issues. In the case of iodine deficiency, previous reports have highlighted that many unsupplemented milking cows have iodine deficiency in Ireland (Mee, et al., 1993). The Dairy Herd Health Group at UCD has in some cases had concern that iodine deficiency was causing lower than desired milk yield (in mid-late lactation cows). Furthermore, well recognised nutritional bodies (NRC, 2001) recognise that deficiency of phosphorous, iodine and copper all have implications for reproductive outcomes. Thus, it is important that all milking cows are supplemented with appropriate allowances of major minerals and trace elements.

Conclusion

The most important aspect of dry cow nutrition is to ensure an appropriate BCS at calving of 3.0 to 3.25 for 90% of the herd. Grass silage-based dry cow diets can be and are often used successfully. Care should be taken to ensure grass-silages are always analysed so that appropriate energy, protein, mineral and trace element allowances can be provided. For early lactation cows, diets should be balanced to supply 100% of UFL requirements where possible. This will ensure that BCS loss is minimised and that negative energy balance is not a major factor in reduced fertility performance. Concentrate type may have an influence on metabolic status and subsequent reproductive performance in the grazing cow.

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