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Review

Welfare-positive management and nutrition for the dairy herd: A European perspective

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ABSTRACT

As European dairy farms become larger and diverge between grass-based and fully housed systems, interest in the welfare of the dairy cow and related environmental issues by consumers and legislators is increasing. These pressures mean that good nutrition and management, which underpin much dairy cow welfare, is critical. Despite considerable research into the management and nutrition of the dairy cow from calf to adulthood there is much on-farm variability in its application. While the incidences of many endemic diseases are reduced most are still significant, for example lameness. In addition, trade and climate change are bringing a more diverse range of pathogens, parasites and pests into Northern Europe. Housing aspects are limited in application by economics and in most cases still do not match grazing for welfare in temperate climates. Genomic technologies offer increased opportunities to breed for 'robustness' but like 'precision animal management systems' have still to be fully exploited.

Introduction

Recent United Kingdom proposals to establish 'super herds' with cows essentially permanently housed has highlighted public (Anon, 2005) and scientific interest in dairy cow welfare (van Driel, 2008; Anon, 2009a, 2010a). There is currently a worldwide discussion of this concept (Knowlton and Denckla Cobb, 2006; Macleod and Moller, 2006; Schmalzried and Fallon, 2007; Alvarez et al., 2008; Lean et al., 2008; Ghebremichael et al., 2009) that has also embraced wider societal needs (Wang et al., 1999; Kirkwood, 2007; Boogaard et al., 2008; Verbeke, 2009) and influenced the European Union (EU) Animal Health Strategy (2007–2013) which, somewhat artificially, separates 'health' from 'welfare' (Broom, 2007).

This article aims to review dairy cow welfare issues that are well documented (Anon, 2009b) from calfhood through to culling (or death), and, where possible, suggest how the effects of the major risk factors for these can be limited by good nutrition and informed management inputs.

The dairy heifer: Welfare issues from calfhood to entry to the milking herd

Calf welfare issues

Most farms rear the majority of their own replacements and the ability to ensure their entry to the adult herd at the most cost-effective time is dependent on ensuring good controlled growth rates and welfare, most particularly heath. In the UK, calf losses (male and female) are estimated at 10% and occur as follows: stillbirth, 2%; birth–24 h, 3%; 1–28 days, 3%, and 29–182 days, 2% (Ortiz-Pelaez et al., 2008; Brickell et al., 2009). These data vary greatly, partly due to underlying infections such as bovine viral diarrhoea (BVD) virus (Ersbøll et al., 2003; Osteras et al., 2007). The virtual eradication of BVD in some European countries and continuing eradication programmes in others is a matter of satisfaction (Barrett et al., 2011). Bluetongue (BTv) and Schmallenberg virus (SBv) are further recent sources of loss and their spread in Northern Europe is concerning (Dal Pozzo et al., 2009; Anon, 2010a; Gibbens, 2012).

Roughly 20% of calves fail to absorb sufficient colostral antibodies (threshold IgG > 10 g/L or a zinc sulphate turbidity test >12 units) leading to increased mortality and, in some studies, reduced lifetime productivity (Drackley et al., 2007; Godden, 2008; Beam et al., 2009; Dawson and Moss, 2009; Vasseur et al., 2009). Further, there is a considerable variation in the IgG fractions of dairy cow colostrum (threshold 50 g/L IgG) influenced by breed and/or yield component, season/housing, and mastitis (Tyler et al., 1999; Weaver et al., 2000; Moore et al., 2005; Gulliksen et al., 2008).

Single suckling encourages good growth rates and health and some organic dairy systems are piloting calf suckling during lactation (Krohn, 2001; Weary, 2005; Wagenaar and Langhout, 2007; Oudshoorn et al., 2009; Marley et al., 2010). However automated milk feeders (AMF), which allow more feeds/day, greater intakes and higher dietary protein content than standard bucket fed calves,

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is a more practical option despite limited evidence of positive effects on subsequent cow performance (Carson et al., 2002; Garnsworthy, 2004; von Keyserlingk et al., 2004, 2009; Weary, 2005; Robinson et al., 2006; Drackley et al., 2007; Morrison et al., 2009; Raeth-Knight et al., 2009).

Field AMF data show considerable calf visits recorded as 'Occupancy but no available Milk' compared to 'Successful', and this needs more evaluation related to calf numbers per machine (Luescher et al., 1989; Froberg and Lidfors, 2009). Lastly, all calves should have free access to water (Pettersson et al., 2001; Howard, 2004; Hepola, 2008). Thus calf welfare depends on good rearing practice, accurate health recording and veterinary investigation leading to targeted prevention (Menzies et al., 1994; Esslemont and Kossaibati, 1996; Mellor and Stafford, 2004; Anon, 2006, 2010b; Osteras et al., 2007; Ortiz-Pelaez et al., 2008).

Welfare issues for young stock and the first calving heifer

Replacement heifers are frequently housed for their first year, predisposing to disease problems such as pneumonia, even though good growth rates can be achieved under well-managed grazing systems (Carson et al., 2002). High planes of nutrition during the pre-pubertal period have been shown to inhibit mammogenesis and reduce milk yield (Sejrsen and Purup, 1997). However, high genetic merit Holstein–Friesian (HF) heifers can achieve growth rates up to 0.95 kg/day calving at 2 years on *ad lib* good quality grass silage or well managed grazing without compromising subsequent performance (Carson et al., 2000, 2002; Le Cozier et al., 2008).

Since many European Union (EU) heifers are grazed extensively this may, at least in part, explain the 'weak calf syndrome' (Berglund et al., 2003). Many factors have been examined but none seems to explain the problem fully (McCoy et al., 1997; Smyth et al., 1999). Grazing predisposes to helminth disease (including paramphistomiosis), thus strategic treatment and anthelmintic resistance and changes in geographic distribution, possibly associated with climate change, all impact on grazing management (Ross et al., 1968; Coles and Stafford, 2001; Pritchard et al., 2005; Coles et al., 2006; Dreyfuss and Rondelaud, 2008; Foster et al., 2008; Fairweather, 2009; de Waal, 2010; Hogg et al., 2010).

Climate change, coupled with 'free trade', may also explain the northerly encroachment in Europe of insect-transmitted diseases, such as BTv, SBv, *Besnoitia besnoiti* and *Parafilaria bovicola* (Losson and Saegerman, 2009; Schares et al., 2009). These, parasitic and other diseases, such as BVD, have implications for farm biosecurity, and similar considerations for older lactating cattle (Forbes et al., 2004, 2007; Salimi-Bejestani et al., 2005, 2008) requiring an understanding of 'risk limiting strategies' (Moennig et al., 2005; Gunn et al., 2008; Menzies et al., 2008; Heffernan et al., 2009). 'Biosecurity' includes limiting foodstuff contamination and not just on-farm (D'Mello, 2004). In particular there is more to learn about the transmissible spongiform diseases (Johnston, 2005) as shown by the recent identification of three types of bovine spongiform encephalopathy (BSE) (Stack et al., 2009). While cost sharing of disease control by the industry rather than government is laudable, discussion of specific entities (e.g. bovine tuberculosis (bTB) and foot-and-mouth disease (FMD)) is more fraught (Sellers and Gloster, 2008; Gunn et al., 2008; Dal Pozzo et al., 2009; More, 2009).

Limiting food intake is common in heifers post-calving. Inadequate training to housing systems and poor design, such as feed face access and lying comfort, reduce productivity and health, e.g. these are risk factors for lameness (Logue and Bergsten, 2007; DeVries and von Keyserlingk, 2009). Although data are limited, habituation of heifers to the milking parlour routine prior to calving appears advantageous, as is bedding on a straw yard for some time post-calving (the minimum to be defined) prior to introduction to the main herd (Webster, 2002; Wicks et al., 2004; Logue et al., 2004; O'Connell et al., 2008). Introducing lactating heifers into the adult herd in pairs (at least), and in the evening rather than morning, seems significantly less disruptive (Boyle et al., 2010), though still challenging for these animals (Chaplin et al., 2000; O'Connell et al., 2008).

Nutritional management of the periparturient and lactating dairy cow

The HF is now the dominant dairy cow breed but its high metabolic turnover requires sophisticated management, particularly during the 'transition period' (approximately 3 weeks before and after calving). Roughly 1 in 10 cows are treated for some illness either during or linked to this period and failures of transition management predispose the cow to hypocalcaemia, mastitis, lameness and reproductive problems (Peeler et al., 1994; Offer et al., 1999; Bradley and Green, 2000, 2001; Goff, 2003; Sheldon et al., 2008). Fortunately the demands of rumination and its efficient nutritional management are increasingly well understood with various software available to aid in dietary formulation (Thomas, 2004).

Body condition score and the transition cow

The practical importance of limiting weight loss in early lactation is well understood but less easy to manage (Robinson, 1997; Garnsworthy and Webb, 1999; O'Callaghan and Boland, 1999; Butler, 2000; Roche, 2006; Mulligan et al., 2009; Roche et al., 2009). 'Fat cows' at calving have reduced food intake in early lactation leading to a large negative energy balance (NEB) i.e. calorific intake much less than demand, with resultant increased tissue mobilisation (especially fat reserves), bodyweight and condition loss leading to reduced fertility and increased health problems. This has led to a simple scoring of fat cover, 'body condition scoring' (BCS) with the 1–5 scale being the most commonly applied in the EU (Broster and Broster, 1998; Bewley et al., 2010).

Long-term selection for yield and other 'dairy qualities' may limit the value of BCS reduction as cows become more dependent on mobilising deeper body fat (e.g. omental fat). This has implications for future genetic selection for fertility but the recommended objective for the dry period remains to achieve a BCS of 2.5 (1–5 scale), with slightly higher levels, just under 3, for pasture-based systems, and to maintain that to calving (Veerkamp and Emmans, 1995; Friggens et al., 2004; Garnsworthy, 2006; Roche et al., 2009). Regular automated weighing coupled with dorsal image analysis and ultrasound as cows exit from milking may increase the value of body fat store measurements (Ren et al., 2002; Ferguson et al., 2006) and become part of a precision management system (PMS) that applies a number of other technologies, such as automated milking. Altogether PMS may allow individual attention in large herd situations, ensuring efficient use of costly resources, especially nutrients (Khanal et al., 2010).

The cow must arrive at calving not only in the correct condition but also 'primed' in terms of rumen function and element balance. At its simplest this transition diet (TD) in the last 3–4 weeks of gestation is based on a restricted intake of approximately one-third of the milking cow ration but additional refinements are the addition of long fibre (straw) along with the restricted forage, and an increase in the level of rumen undegradable protein. Attempts to counteract body tissue mobilisation in the late dry period by increasing the supply of fermentable energy (e.g. starch) and reducing fat generally does not benefit subsequent performance and, in some cases has increased the incidence of metabolic disorders (Friggens et al., 2004; Law et al., 2009).

Limiting periparturient milk fever is essential. Cows grazing in late pregnancy in the autumn in Northern Europe are particularly at risk, as this can result in a calcium rich, magnesium deficient