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Review article

Importance of outdoor shelter for cattle in temperate climates

Eva Van laer [a,*], Christel Palmyre Henri Moons [b], Bart Sonck [a], Frank André Maurice Tuyttens [a,b]

[a] Institute for Agricultural and Fisheries Research (ILVO)-Animal Sciences Unit, Scheldeweg 68, 9090 Melle, Belgium
[b] Department of Animal Nutrition, Genetics, Breeding and Ethology, Faculty of Veterinary Medicine, Ghent University, Heidestraat 19, 9820 Merelbeke, Belgium

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ABSTRACT

It is well documented that health, welfare and productivity of cattle in (sub)tropical and cold regions can be improved by measures that mitigate the adverse effects of extreme climatic conditions. In temperate regions, however, the need for and effectiveness of such measures has received much less attention.

The aim of this review is to give an overview of the most relevant climatic factors, animal characteristics and adaptation strategies that have to be taken into account when assessing the need for mitigating measures for cattle on pasture, more specifically in temperate areas. Belgian climatic data are used to show that conditions outside the thermo-neutral zone of certain cattle types, possibly leading to cold or heat stress and impairment of production if persistent, occasionally occur even in temperate climates. Such thermal stress is likely to become more common in the future, due to global warming and cattle's decreased capacity for thermoregulation caused by selection for high productivity. Recent research is reviewed to show that the traditional climatic indices and threshold values of the associated heat stress risk classes are outdated, too strongly focused on hot climates, and too general to evaluate heat stress in the different (mainly high-producing) cattle types bred in temperate areas nowadays. Nonetheless, the (currently limited) knowledge on the effect of adverse weather on pastured cattle in temperate climates suggests that providing shelter will benefit their welfare and productivity. Further research is needed, however, to estimate the effectiveness of different types of shelter for different types of cattle (for instance those differing in age, breed, experience and productivity).

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* Corresponding author. Tel.: +32 90272 26 24.
E-mail addresses: eva.vanlaer@ilvo.vlaanderen.be, evavanlaer@gmail.com (E. Van laer).

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1. Introduction

In most temperate regions, beef and dairy cattle are kept on pasture for at least some part of the year. Pasturing has some important benefits for animal health and welfare, like a decrease in claw and leg problems (Haskell et al., 2006; Hernandez-Mendo et al., 2007). Timing, duration and synchronisation of different behaviours are less restricted on pasture (Bracke and Hopster, 2006; O'Connell et al., 1989) and the greater space allowance also reduces aggression (Kondo et al., 1989; Wierenga and Hopster, 1990). Pasturing can also have benefits related to farm profitability (Dillon et al., 2005), environmental sustainability (Peyraud et al., 2010) and the public image of the beef and dairy sector (van den Pol-van Dasselaar, 2005) as well. On the other hand, it poses certain disadvantages and risks, such as additional labour to move animals (e.g. for milking), a less stable ration quantity and quality, a higher exposure to endoparasites like lungworms and liver fluke, and exposure to adverse weather conditions (van den Pol-van Dasselaar, 2005).

In comparison with temperate, mid-latitudinal areas, summers and winters are long and severe in (sub)tropical and high-latitudinal areas, respectively. In these regions, both livestock keepers and the public as well as scientists have since long been aware of the effects of exposure to cold and heat on livestock behaviour, physiology, welfare and productivity (Collier et al., 1982a; Kadzere et al., 2002; Silanikove, 2000; Young, 1981) and the effectiveness of preventive measures thereupon (Armstrong, 1994; Blackshaw and Blackshaw, 1994; Gregory, 1995). The importance of prevention of cold and heat stress for cattle in temperate regions, however, is sometimes contested.

Cattle may adapt to chronic situations of relatively mild cold by accumulating energy reserves (body fat and muscle tissue) and by growing subcutaneous fat and thicker coats which provide increased insulation. The potential for such adaptation depends on environmental factors and animal phenotypic and genetic traits. Energy demand and efficiency are determined by body weight and growth rate, as well as by cattle type or breed. Robust and slow growing livestock breeds like the Scottish Highlander, Galloway, Hereford and Aberdeen Angus are characterised by low energy demands and a high potential to accumulate fat on a poor quality diet. As such, they are assumed to be relatively resistant to cold conditions, even under nutritional limitation. Therefore, these breeds are often kept outdoors year-round, for example for the purpose of grazing management in nature reserves (Wallis de Vries, 1994). On the other hand, faster growing and highly productive commercial beef and dairy breeds such as the Holstein, Jersey, Charolais, Limousin, Blonde d'Aquitaine and Belgian Blue, have higher basal metabolic rates, growth rates and thus higher energy requirements (Wallis de Vries, 1994). These breeds are considered less suited to be kept in a wide range of climatic conditions and, in deep winter, they are generally kept indoors. Summer conditions are generally – but maybe unduly – considered less problematic for cattle in temperate areas, and the animals often stay on pasture for most of the time. However, on the hottest summer days, unsheltered outdoor conditions can be assumed to be difficult to cope with, especially for high producing dairy cattle, as will be elaborated further in this review.

Next to seasonal challenges to thermal tolerance, livestock may also suffer thermal stress during intermittent extreme weather events such as hot spells, cold spells or storms. In these cases there is much less potential for adaptation. However, for livestock keepers, such extreme weather events seem to pose a greater challenge in terms of management, since they are unpredictable and they will thus require provisions for mitigation to be present at all times, requiring labour and economic investment that will not necessarily or immediately pay off. Also the public expresses concerns about the welfare of outdoor-housed cattle when climatic conditions are, or appear to be, severe. Although governmental services and animal protection organisations raise awareness and provide advice related to thermal comfort, legislation is often lacking, inconclusive or unclear about which measures (indoor or outdoor housing, with or without additional measures such as shade or shelter on pasture) ought to be taken when in order to prevent thermal stress.

2. Climatic variables that contribute to thermal stress

The physiological responses of animals to low and high temperatures are often presented on a bidirectional continuum divided into different zones (Fig. 1). Within the zone of thermal comfort an animal has an optimal experience of comfort in relation to environmental temperature. Within the thermo-neutral zone, i.e., when the ambient temperature is between the lower critical temperature (LCT) and the upper critical temperature (UCT), it has to invest only a minimum of energy in maintaining its body temperature (e.g. vasodilatation of peripheral blood vessels provides enough cooling) (Silanikove, 2000). Once the ambient temperature ventures outside of the thermo-neutral zone, the animal is required to increasingly invest metabolic energy in heat dissipation or heat production. The energy available for other bodily functions will diminish. If this situation persists, the animal experiences stress, and health and production are impaired. Outside the zone of homeothermy the thermoregulatory mechanisms fail to keep body temperature within the normal range. Health declines even further, which may eventually lead to death.