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PERFORMANCE OF DAIRY COWS DURING DIFFERENT SEASONS WITH DAILY HERBAGE ALLOWANCE: *A REVIEW*

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ABSTRACT

Pasture-based feeds are favored nowadays due to their cost-effectiveness and effect on animal welfare. Daily herbage allowance (DHA) affects the performance of dairy cows across different seasons. The key determinant of the performance of livestock is the dry matter intake (DMI) of herbage in pasture-based systems. A decline in average summer rainfall may result in considerably higher concentrate supplementation requirements to compensate for the loss in pasture growth and availability during autumn. Supplementation during autumn and winter boost total DMI and sustain milk output under grazing restrictions. Generally, milk production increases at high DHA but has no significant influence on milk fat content. In Spring, greater milk production lessens cows' maintenance energy needs, and lower pasture content is linked to lower methane generation in the rumen. Methane generation declines in summer with increased digestibility at high intake levels. It is recommended to conduct an experiment exhibiting all seasons to eliminate factors that may affect the results across various studies. This review will understand variation in daily herbage intake of cows at pasture that allows the management of total intake to optimize milk production and identification of cows that are more efficient at converting feed into milk.

Keywords: *DHA (daily herbage allowance); OMI (organic matter intake); difference season, performance; dairy cattle*

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INTRODUCTION

The quantity of daily herbage per cow that is above a specified height is known as daily herbage allowance (DHA) is extensively recognized as the main driver behind the productivity of grazing-based dairy systems, which is dependent on pre-grazing herbage mass and stocking rate (Stakelum et al., 2007). There is a curvilinear relationship between both DHA and organic matter intake (OMI) in milk yield. Generally, low DHA increases grazing pressure which can maximize profitability by increasing herbage utilization and milk production while high DHA negatively affected herbage quality due to increased amounts of rejected pasture leading to unnecessary costs (Merino et al., 2020).

The influence on herbage chemical composition, grazing behavior, and pre-grazing herbage mass (HM) appears to be a major determinant in determining animal performance and herbage DMI (Wims et al., 2010; Pérez-Prieto and Delagarde, 2012). To provide enough feed for the cows, intensive use of grassland for dairy production is dependent on frequent assessments of herbage supply and grazing severity (O'Donnell et al., 2008). The herbage-supply requirements for grazing and silage management are used to budget feed supply. With the use of a visual evaluation approach to estimate herbage availability, utilizing DHA and herbage-supply targets to determine grazing management decisions is a viable alternative (O'Donovan *et al.,* 2002).

Butler *et al.,* (2003) discovered that higher productive herds require more DHA. Daily milk supply, on the other hand, fluctuates with lactation stage, and as lactation progresses, dairy cows allocate more energy to body reserves. As a result, the effect of DHA on milk supply may differ depending on the stage of lactation. Seasonal fluctuations in herbage quality and sward structure complicate progressing lactation stage. This review will understand variation in daily herbage intake of cows at pasture that allows the management of total intake to optimize milk production and identification of cows that are more efficient at converting feed into milk.

METHOD A REVIEW

This literature review is from different academic research papers. After collecting the articles, analyze each one by breaking it down and identifying the important information and then synthesize and identify the conclusions that can be drawn.

RESULT AND DISCUSSION

Effects of DHA in dairy cattle during spring

In recent years, farmers provide spring grass to livestock for improvements in fall closure management with the introduction of new grass (Gilliland, 1995), and the use of feed budgeting techniques (O' Donovan, 2000). Although these advancements have been made, even in the best-case scenario, grass supply is still restricted in the spring, necessitating the need to increase the quantity of energy in the diet of lactating cows during this season. To obtain a high level of milk production while maintaining a lengthy first-grazing cycle, it is still necessary to supplement with concentrate or other readily available supplements (grass silage, maize silage, etc). Longer first rotations guarantee that the animal has access to enough grass until grass growth exceeds the animal's requirements.

Milk production, performance production, and methane production

DHA's impact on dairy cow productivity and grazing has been well researched (Bargo *et al.,* 2003; McEvoy *et al.,* 2008). Daily herbage allowances of 20 to 40 kg DM per cow per day increased milk production from 0.05 to 0.19 kg per kilogram increase in DHA (above ground level) (Pérez-Prieto and Delagarde, 2013). Decreased DHA is thought to be related to a higher stocking rate. Herbage availability and, as a result, milk output per cow

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decreases when the stocking rate rises (McCarthy *et al.,* 2011). On the other hand, a decrease in pasture consumption linked with lower DHA had no significant influence on individual milk production (Merino *et al.* 2018) which may be associated with the low energy balance leading to increased milk production efficiency in dairy cows (Pérez-Prieto and Delagarde, 2013). Higher stocking rate as DHA dropped led to better milk production per ha (+27%) (Merino *et al.* 2018), that caused by the increased herbage consumption (Macdonald *et al.,* 2008), which can enhance the long-term economic performance of grazing dairy systems.

Generally, concentrate levels have no influence on milk fat concentration, as observed by Dillon *et al.* (2002) Kennedy *et al.* (2007c), McEvoy *et al*. (2008), and Merino *et al.* (2018) in the early lactation. However, it disagrees with studies by Delaby *et al.,* 2001; Bargo *et al.,* 2002 in the mid-lactation where animals were supplemented with greater than 5 kg/cow per day, probably due to a dilution effect caused by milk yield increasing more quickly than milk fat when the concentrate is given into the diet in mid-lactation. The influence of performance and milk content is shown in table 1.

Table 1, the influence of performance and milk content with DHA in cattle during spring

Performance	Influence on milk protein	Influence on milk fat	Reference
-	-	No	McEvoy et al. (2008)
-	increase	No	Maher et al. (2003).
Increase body weight gain	No	-	Kennedy et al (2007)
Increase body weight gain and decreased body weight loss	-	-	Dillon *et al.* (2002), Delaby *et al.* (2003), Horan *et al.* (2005), McEvoy *et al.* (2008).
Increase body weight gain	-	-	McEvoy*et al.* (2008)
the body weight and body condition score were inapparent	-	-	Bargo *et al.* (2002) Merino *et al.* (2018)

Loza *et al.* (2021) found no differences in total enteric CH4 emissions (363 g/d on average) or CH4 emission intensity (18.4 g/kg FPCM on average), and the findings are consistent with previous international Munoz *et al.* (2016); Westberg *et al.* (2001); Zubieta *et al.* (2020). Furthermore, Loza *et al.* (2021) reported an average CH4 emission per unit of the estimated feed intake at 21 g/kg DMI and CH4 emission as a percentage of gross energy intake, which is consistent with previous findings of Dini *et al*. (2021) and Cottle *et al.* (2018), which performed meta-analysis for grazing dairy cows on temperate pastures.

Effects of DHA in dairy cows during summer

Milk production in pasture dairy systems is tightly linked to changes in herbage availability and, as a result, herbage growth rate, with high output in the spring and lower production in the summer. As a result, optimizing grazing management throughout the summer is one strategy to reduce the seasonality of milk output (Evers *et al.,* 2021).

Daily herbage intake

To make significant comparisons across multiple studies, it is necessary to consider the amounts of DHA that are being compared, the cutting height of herbage that is being harvested, and the level of production of the experimental animals. The majority of strip grazing trials have established a curvilinear association between OMI and DHA (Romera et al., 2010) On the other hand, Stakelum *et al.* (2007) did not find evidence of a curvilinear influence of DHA on consumption. The most likely explanation is that a significantly smaller range of DHA was used in the latter than

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in the previous studies. It was effective in both experiments by Stakelum *et al.* (2007) to maintain identical swards for the same DHA levels by mechanical topping after each grazing session.

Milk production, performance production, and methane production

The potential of cow milk production was measured by using the likely milk yield (LMY) (Delaby *et al,* 2001). Cows were provided ad libitum maize silage, grazed grass, and concentrates at turnout in April, and this was used as their reference milk yield. Due to poor weather conditions during the pre-experimental milk yield (PMY) period, the PMY period in the studies conducted by Stakelum *et al,* (2007) was different in that the cows grazed to 60 mm and were given 0.5 kg of supplemental concentrates per day, except for the last week, when they were given 4 kg/day. The influence of performance and milk content with DHA in cattle during summer is shown in table 2.

Table 2 The influence of performance and milk content with DHA in cattle during summer

Treatment	Result	Reference
full grazing season and stocking rate	no considerable difference in milk production	Stakelum et al. (2007)
grazing high swards	higher quality milk production	Stakelum and Dillon, 2007)
grazing high swards	Higher milk production	cEvoy et al., 2009 and Curran et al., 2010
Grazing low rates	no significant influence on milk output and milk solids per cow	Perez-Prieto et al. 2018
grazing high swards	Milk production and herbage consumption were lower with	Munoz et al. (2016)
DHA	milk fat content	Maher *et al.* (2003) Stakelum *et al.* 2007

Low pre grazing high swards had higher proportions of grass leaf and lower proportions of stem and dead material, according to Hoogendoorn et al. (1992), leading to higher dry matter digestibility values and, as a result, higher milk output per cow. According to Maher *et al.* (2003), the content of milk protein increased linearly with the amount of DHA in the milk and the values for milk protein concentration observed in summer are quite high. There is little research on CH4 production from grazing dairy cows in the literature and even less on measuring the impacts of herbage quality on CH4 production. Beef calves provided zero-grazed grass with varied pre-grazing highs did not differ in intake-corrected CH4 emissions, according to data from beef cattle (Hart *et al.,* 2009). In later grazing research, the authors found that animals given a low sward had lower CH4 emissions per kilogram of live weight growth (Boland *et al.,* 2009). In a study conducted by Wims et al. (2010), there were differences in leaf, stem, and dead proportions across treatments, as well as a variation in regeneration interval, while the chemical content of the treatments differed due to changes in sward texture and regrowth interval. Total CH4 production was connected to the intake of numerous plant fractions and greater amounts of CP and lignin, resulting in decreased CH4 generation.

Effects of DHA in dairy cows during autumn

Allocating herbage in a high-quality pasture is effective in enhancing herbage consumption and milk output per hectare while sustaining the short-term conditions of a pasture grazed by dairy cows in

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autumn. When compared to providing more grazing space or a higher amount of supplements to animals, this would represent an economic gain, as long as the possible marginal increase in expenditures does not offset the marginal rise in revenues from the more milk produced, as well as a method to improve the economic and biological sustainability of pasture-based dairy production systems. Furthermore, the amount of DHA in the diet must be modified during the subsequent spring and summer seasons (Merino *et al.,* 2019). The influence of performance and milk content with DHA in cattle during autumn Table 3.

Table 3. The influence of performance and milk content with DHA in cattle during autumn

Treatment	Result	Reference
increasing pasture intake at the high DHA content	enhance individual milk production and lower milk fat concentration	Merino *et al.* (2019)
increase in herbage DM intake	increased milk yield	Gross *et al.,* 2011
increasing DHA	lowers B-hydroxybutyrate in plasma	Morales *et al.* (2016)
increasing DHA	individual milk output per cow increased	Pulido *et al.* (2010) and Pérez-Prieto *et al.* (2011)
increasing DHA	no proof of an effect of DHA	Ruiz-Albarrán *et al.* (2012), Kennedy *et al.* (2007)
stocking rate (SR)	individual milk production is lowered	McCarthy *et al.* (2011),

Pasture availability treatment had no significant influence on animal intake and performance throughout fall, which was comparable with the low effect on pasture performance. The overall levels of DMI and milk production, which were comparable across studies (Coffey *et al.,* 2018; Claffey *et al.,* 2020; Evers *et al.,* 2021), indicate the strong productivity potential of fall pasture. Likewise, multiple earlier studies (although short-term) have shown that high HM swards may sustain enhanced milk output per hectare (Holmes *et al.,* 1992; Kennedy *et al.,* 2006). Claffey *et al.* (2020) and Evers *et al.* (2021) found no significant influence of early and delayed fall closure techniques on milk and MS yield during the autumn, but Claffey *et al.* (2020) found that greater pasture availability in the spring resulted in improved animal performance.

When high-quality pastures are available in the autumn, the CP supply for dairy cows typically surpasses their requirements for milk production, although energy intake is the most significant nutritional limiting factor (Hills *et al.,* 2015). As a result, the use of supplementary feed is required to provide a consistent supply of energy in terms of both amount and quality, in order to prevent the energetic expenditures associated with excreting nitrogen through urea production and to optimize rumen microbial synthesis, which enhances dietary N consumption (milk N in relation toN intake) (Nichols *et al.,* 2019; Hristov *et al.,* 2005). Neither the quality of the feed offered (since forage and MSS quality did not differ in CP nor ME concentrations) nor the total DM consumption was found to be associated with the increased milk protein reported in Merino et al's (2020) study, at high DHA. In the presence of increased herbage, the increase in milk protein content seen by Morales *et al.* (2016) could be explained by a decrease in the plasma concentration of B-hydroxybutyrate, which has been shown to have a beneficial impact on energy metabolism. For every kilogram of increase in DHA in Merino et al (2020) study, the milk protein content rose by 0.01 grams per kilogram of rising in DHA, which is

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similar to the findings of Delaby *et al.* (2001).

Effects of DHA in dairy cows during winter

For dairy cows, efficiently grazed pasture is generally acknowledged as the most cost-effective source of nutrition. The larger the amount of grazed pasture in a dairy cow's yearly diet, the better the potential for economic efficiency in dairy systems (Dillon *et al.,* 2005). Consequently, extending the grazing season into late winter is an appealing strategy for lowering feed expenditures. On the other hand, winter grazing entails grazing cows through periods of rain, cold temperatures, and short day lengths, with pasture supply often restricted owing to a low pasture growth rate. As a result, grazing low-mass pastures throughout the winter is quite likely (Perez- Prieto *et al.,* 2010). When it comes to increasing the amount of grazed herbage in the yearly diet of dairy cows, winter grazing is a good tool for doing so. During this season, herbage growth rate, herbage allowance, and herbage intake are all lower than normal. As a result, supplementation is more necessary to provide the nutritional demands of nursing dairy cows than during any other season (Ruiz-Albarran *et al.,* 2016). The influence of performance and milk content with DHA in cattle during autumn Table 4.

Table 4. The influence of performance and milk content with DHA in cattle during autumn

Treatment	Result	Reference
increasing DHA	no impact on milk production in cows at the start and middle of lactation	Kennedy *et al.* (2008); Ruiz-Albarran *et al.* (2016)
reducing DHA	reduced milk yield	Pérez-Prieto *et al.* (2011)
increase in pasture intake	milk production increased	Perez-Prieto *et al.* (2010)
grazing short swards in a vegetative state	superior milk urea N (MUN) found in the high herbage allowance	Ruiz-Albarran *et al.* (2016); Kennedy *et al.* (2008)

The lack of variability in milk protein contents between treatments is due to a null variation in energy supply. The increased CP intake from the herbages, caused by grazing short swards in a vegetative state, may have resulted in the superior milk urea N (MUN) found in the high herbage allowance. According to previous research by Schöbitz *et al.* (2013), paddocks grazed with high herbage allowance had more dead material than paddocks grazed with low herbage allowance.

Measuring the concentration of blood metabolites provides an indicator of the balance between nutrition supply and energy and protein needs (Wittwer, 2012). As a result, butyrate absorption from the rumen, which is connected to the butyric acid in the silage-supplemented diet, appears tobe the cause of the rise in plasma in the study of Ruiz-Albarran *et al.* (2012). Excess rumen ammonia passes into the bloodstream and is converted to urea by the liver, resulting in a high ureacontent in plasma or milk. The reference interval for plasma urea concentrations is 2.6 to 7.0 mmol L-1 (Wittwer, 2012), which suggests ruminal energy/protein synchronization and is related to high degradable protein content in the diet. Plasma cholesterol concentrations are usually similar in cows grazing the two herbage allowance, which might be due to greater ruminal acetate and butyrate synthesis as a result of a higher silage consumption in the diet.

CONCLUSION

Supplementation during autumn and winter boost total DMI and sustain milk output under grazing restrictions. Generally, milk production increases at high DHA but has no significant influence on milk fat content. In Spring, greater milk production lessens cows' maintenance

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energy needs, and lower pasture content is linked to lower methane generation in the rumen. Methane generation declines in summer with increased digestibility at high intake levels. It is recommended to conduct an experiment exhibiting all seasons to eliminate factors that may affect the results across various studies.

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