



J. Dairy Sci. 101:1–10
<https://doi.org/10.3168/jds.2017-13604>

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A national methodology to quantify the diet of grazing dairy cows

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ABSTRACT

The unique rumen of dairy cows allows them to digest fibrous forages and feedstuffs. Surprisingly, to date few attempts have been made to develop national methods to gain an understanding on the make-up of a dairy cow's diet, despite the importance of milk production. Consumer interest is growing in purchasing milk based on the composition of the cows' diet and the time they spend grazing. The goal of this research was to develop such a methodology using the national farm survey of Ireland as a data source. The analysis was completed for a 3-yr period from 2013 to 2015 on a nationally representative sample of 275 to 318 dairy farms. Trained auditors carried out economic surveys on farms 3 to 4 times per annum. The auditors collected important additional information necessary to estimate the diet of cows including the length of the grazing season, monthly concentrate feeding, type of forage(s) conserved, and milk production. Annual cow intakes were calculated to meet net energy requirements for production, maintenance, activity, pregnancy, growth, and live weight change using survey data and published literature. Our analysis showed that the average annual cow feed intake on a fresh matter basis ranged from 22.7 t in 2013 to 24.8 t in 2015 and from 4.8 to 5 t on a dry matter basis for the same period. Forage, particularly pasture, was the largest component of the Irish cow diet, typically accounting for 96% of the diet on a fresh matter basis and 82% of dry matter intake over the 3 yr. Within the cows' forage diet, grazed pasture was the dominant component and on average contributed 74 to 77% to the average annual cow fresh matter diet over the period. The proportion of pasture in the annual cow diet as fed was also identified as a good indicator of the time cows spend grazing (e.g., coefficient of determination = 0.85). Monthly, forage was typically the main component of the cow diet, but the average contribution of concentrate was substantial

for the early spring months of January and February (30 to 35% of dry matter intake). Grazed pasture was the dominant source of forage from March to October and usually contributed 95 to 97% of the diet as fed in the summer period. Overall, the national farm survey from 2013 to 2015 shows that Irish dairy farms are very reliant on forage, particularly pasture, regardless of whether it is reported on a dry matter basis or as fed. There is potential to replicate this methodology in any regions or nations where representative farm surveys are conducted.

Key words: milk, dairy, pasture, grass, cows

INTRODUCTION

Grass from grazing land (pasture) is an important source of feed for dairy cows in many parts of the world. When managed correctly, pasture is a very nutritious feed, which allows dairy cows to produce milk rich in protein, n-3, vitamins, and minerals. Consumers usually consider pastoral farming as healthy, animal friendly, and an environmentally sustainable method of milk production (Heerwagen et al., 2013; Elgersma, 2015). The rising consumer interest in how foods such as milk are produced has led to the development of milk brands that only allow farmers feed their cows grass [e.g., Organic Valley's Grassmilk (Wall Street Journal, 2014)]. These dairy products are in high demand in some nations and are sold at a market premium price in several supermarkets and convenience stores (Wall Street Journal, 2014; Organic Milk Suppliers Cooperative, 2015).

Consumers' intuition regarding pasture-based farming is not necessarily based on scientific research, but several research studies support their opinion. For instance, regarding animal welfare, research by Olmos et al. (2009), comparing cubicle-housed and pasture-based dairy cows over a full production cycle, showed that a pasture system improved cow welfare in terms of lameness. With regard to human health, a review of research studies by Elgersma (2015) highlighted that milk produced from grazing cows has a higher levels of desirable or healthy PUFA (e.g., α -linolenic acid) than

Received July 31, 2017.

Accepted January 26, 2018.

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milk from housed cows fed TMR diets. Research studies by Rotz et al. (2009) and O'Brien et al. (2012) have highlighted how pasture can improve the environmental performance of primary dairy production by reducing greenhouse gas and ammonia emissions. However, some studies suggest grazing pasture has undesirable effects too. For instance, Mu et al. (2016) reported that pasture-based dairy farms had substantially greater nitrogen loss than dairy systems more reliant on grain or concentrate, which may have implications for water quality.

In recent decades, growth in dairy consumption has typically led to farms in most developed nations becoming larger and more intensive (Alvarez and del Corral, 2010; Winsten et al., 2010). Normally, as farms intensify, cows have less or no access to pasture and are instead housed, where they are typically fed ensiled forages and grains. Under these conditions, dairy farmers can carefully control the animal diet to produce more milk per cow than is possible by simply feeding pasture. This allows producers to generate more milk revenue and is often the main reason to move away from pastoral farming. However, this conflicts in some markets with consumer requirements for pasture feeding of cows. As a result, in certain nations, such as the Netherlands, some processors offer greater payments to milk suppliers when cows get access to grass for a minimum period (Elgersma, 2015). This satisfies current market requirements, but provides very little quantitative information on the amount of a cow's diet that comes from pasture and may not actually be advantageous from an environmental or animal welfare perspective.

The sustained market interest in grass-based dairy products is leading to greater consumer requests on the typical quantities of grazed pasture and forage (i.e., grazed pasture and conserved forages) in a dairy cow's diet. The primary goal of our study was to develop a methodology that can address this question by quantifying regularly the annual and monthly amounts of pasture and forage in the diet of dairy cows at a regional or national level. The quantification method was applied in a nation (Ireland) where farmers allow dairy cows to graze grass for most of the year (i.e., 8 to 10 mo). The method was operated using the country's representative farm survey, because this source facilitates regular national estimates of the typical amount of grazed pasture in a dairy cow's diet. Cow forage and pasture intakes were estimated as fed [fresh matter (**FM**)] and in terms of DM primarily to assess the suitability of the fraction of grazed pasture in the cows' fresh or dry diet as an indicator of grazing season length. Another reason for estimating the dairy cow diet as fed was to highlight to consumers the typical fresh quantities of pasture consumed by grazing cows. The development

of this pasture quantification methodology is expected to provide consumers with better information on the contribution of pasture to a cow's diet relative to the current market approach of communicating the minimum period cows have access to pasture.

MATERIALS AND METHODS

Irish National Farm Survey

To quantify pasture and forage consumed on commercial dairy farms we used data collected as part of the Irish national farm survey (**NFS**) from 2013 to 2015 (Hanrahan et al., 2014; Hennessy and Moran, 2015, 2016). The survey primarily collects economic information on costs and revenue, but it does provide additional technical information to estimate animal diets. For instance, O'Brien et al. (2015) previously used the NFS to quantify the carbon footprint of Irish milk. The NFS was established in 1972 and is part of the European Union's Farm Accountancy Data Network (**FADN**). The survey is carried out on a random representative sample of between 900 to 1,200 farms, depending on the total farm population of a given year. The national farm population is recorded annually by the Central Statistics Office (**CSO**). For ease of operation, several farmers stay in the NFS for many years, but after a certain period, farms exit and new farms are introduced to keep the sample representative. All farms in the NFS are weighted according to their area using annual aggregation factors from the national census so that the survey is representative of the national population.

The NFS categorizes farms into 6 different farming systems, namely dairy, tillage, sheep, cattle rearing, cattle other, and mixed livestock. Farms are classified as dairy producers when at least 66% of the standardized gross output of the farm comes from dairy production. For the 3 yr analyzed, 275 to 318 dairy farms were surveyed. This sample size was equivalent to about 2% of the total population of specialist Irish dairy producers. For the period, the national population was typically 16,000 farms. Trained auditors surveyed all farms 3 to 4 times per year. The auditors collected farm financial information, infrastructure data, and farm production information and data on the demographic profile of the farm households. The survey was also expanded to collect technical data on the length of the grazing season, monthly concentrate feeding, type of forage(s) conserved, milk production, and milk composition (Table 1). A half-day training course was provided to auditors on collecting this technical data.

Generally, farmers that participated in the NFS had detailed farm accounts and diaries. Thus, the additional

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