MILK Symposium Introduction: Dairy production in developing countries*

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ABSTRACT

In low- and middle-income countries (LMICs), dairy production is highly valued, and demand for milk is projected to continue to increase markedly over the next few decades. This presents a tremendous opportunity to improve the nutrition, health, incomes, and livelihoods of millions of people with the high-quality protein and bioavailable micronutrients in dairy products. However, low dairy consumption levels, due to low affordability, accessibility, and availability, still typify several LMICs. This is caused by inadequate feeding, management, and genetics; poor transport, cooling, and processing infrastructure; un conducive policy environments; and sociocultural and demographic factors. Strategies to address some of these factors were presented at the MILK Symposium hosted by the Feed the Future Innovation Lab for Livestock Systems during the 2019 American Dairy Science Association Annual Meeting. The papers presented are full manuscripts in this Special Issue of the *Journal of Dairy Science*. They address the importance of dairy products for human health, strategies to address feed, management, health, and food safety challenges in dairy production systems, and sustainability of dairy production in LMICs. They collectively show how strategic interventions can lead to marked improvements in dairy production in developing countries. These will ultimately contribute to meeting the growing global demand for milk and to achievement of the United Nations Sustainable Development Goals.

Key words: milk production, food security, malnutrition, economic development

INTRODUCTION

Despite the association of dairy production with various health benefits (Thorning et al., 2016; Bhupathi et al., 2020) and their inadequate consumption by most

Americans (USHHS-USDA, 2015), public concerns about dairy production and consumption in the United States and other high-income countries have led to recent increases in the availability of plant-based alternatives. In contrast, in many low- and middle-income countries (LMICs), dairy production is highly valued, and demand for milk is projected to continue to increase markedly over the next few decades. In fact, the global demand for milk is expected to increase by 35% by 2030, driven largely by growth demand in Asia in particular, as well as Africa and Latin America (Figure 1; IFCN, 2018). These increases are due to urbanization, increasing education and incomes, and population growth (Bruinsma, 2003; WHO, 2013). The growing demand for dairy products in LMICs presents a tremendous opportunity to use dairying to improve the nutrition, health, incomes, and livelihoods of millions of people. Yet, there is a much more urgent imperative for increased consumption of dairy products in the LMICs. Dairy products are needed to enrich the typically starch-based diets of 800 million low-income people, thereby reducing the high prevalence (>30%) of stunting (stunted physical and cognitive development) in many African and Asian populations (UNICEF/WHO/World Bank, 2018). Stunting, a widely used measure of malnutrition, is associated with poor growth, lower cognitive development (as shown by lower test and intelligent quotient scores), increased susceptibility to chronic diseases such as obesity and diabetes, lower lifelong productivity, and lower economic productivity of nations (Black et al., 2013; Prendergast and Humphrey, 2014). Milk and other dairy products are vital sources of high-quality protein as well as natural and bioavailable forms of micronutrients that are important for preventing stunting, including vitamin A, vitamin B₁₂, iron, iodine, zinc, folic acid and choline, and several others including thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin (vitamin B₃), pantothenic acid (vitamin B₅), vitamin D₃, vitamin B₆, calcium, phosphorus, selenium, and potassium (Dror and Allen, 2011, 2018; USHHS-USDA, 2015; Górská-Warsewicz et al., 2019). Although some studies have associated consumption of milk and dairy products with negative health outcomes such as cardiovascular disease, others have noted that

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Figure 1. Projected volumes of milk (ECM) that will be produced by region in 2030 and percentage increase over 2017 levels (IFCN, 2018). CIS = Commonwealth of Independent States: Bulgaria, Estonia, Latvia, Lithuania, Romania, Russia, Ukraine.

such associations are unfounded (Fekete et al., 2013). This is because milk and dairy products contain important bioactive factors with various health benefits that counter the potential negative effects, including antioxidants, minerals, peptides, and probiotic bacteria (Fekete et al., 2013; Górska-Warsewicz et al., 2019).

Dairy production also plays a vital role in economic development and sustainability of several LMICs, where it provides critically important contributions to nutrient cycling, plays a crucial role in income generation and poverty alleviation, and serves as a vital source of manure for crop production and cooking fuel and women's empowerment. Therefore, countries such as India, Ethiopia, Nepal, Rwanda, and Kenya have prioritized improvement of their dairy industries. For instance, implementation of the White Revolution program and other dairy development programs in India increased milk production by 400% from 1968/1969 to 2003/2004, and transformed the country from a place with an acute milk shortage to become the world's top dairy producer, accounting for about 16% of total global milk production in 2013 (Kurien, 2007; Ohlan, 2013; Deka et al., 2015). Currently, milk contributes close to one-third of the gross income of rural households in India, and the dairy industry contributes most of the 4% livestock sector contribution to gross domestic product (GDP) and 28% to agricultural GDP (AIR, 2018; Mondal, 2019). This places dairying at the front of the Indian government's commitment to double farmers' incomes by 2022 (AIR, 2018; MAFW, 2018). Growth in dairying in Kenya has transformed it to

become the largest agricultural subsector, contributing 4% to GDP (IGAD, 2013). The Rwandan government promotes dairying as a key poverty alleviation strategy through its "Girinka" (one cow per poor family) program. The Girinka program has led to increased incomes, increased crop yields and soil fertility (Kim et al., 2011), improved nutrition, and improved health by increasing affordability of health insurance, and it has made entrepreneurs out of numerous previously malnourished citizens (Ezeanya, 2014).

Globally, dairy consumption levels in LMICs are highly variable. Notoriously low levels of consumption typify the Democratic Republic of Congo, where the average consumption is 1 kg/person per year, which is a small fraction of the recommendations of the World Health Organization (175 kg/person per year) or Food and Agriculture Organization (200 kg/person per year) and an even smaller fraction of that consumed (>300 kg/person per year) in Sweden and Finland (FAO, 2019). Per capita milk consumption is high (>150 kg/person per year) in Argentina, Armenia, Australia, Costa Rica, Europe, Israel, Kyrgyzstan, North America, and Pakistan; moderate (30 to 150 kg/person per year) in India, Islamic Republic of Iran, Japan, Kenya, Mexico, Mongolia, New Zealand, North and Southern Africa, most of the Near East, and most of Latin America and the Caribbean; and low (<30 kg/person per year) in Vietnam, Senegal, most of Central Africa, and most of East and Southeast Asia (FAO, 2019).

The low consumption of dairy products in LMICs in East and Southeast Asia as well as sub-Saharan Africa

(excluding South Africa) is partly due to low availability, affordability, and accessibility of dairy products (McDowell, 1981; Kapaj, 2018). Underlying issues affecting affordability and availability include shortage of quality feed and adequate land, inadequate cow and milking management and housing facilities, small herd sizes, prevalence of low-genetic-merit breeds, weak disease prevention and control systems, poor transport, cooling and storage infrastructure, weak markets, and unconducive policy environments (McDowell, 1981; Kapaj, 2018).

More salient contributors to the low consumption levels include sociocultural and demographic factors such as food taboos, sex, education level (Kapaj, 2018), and religious fasting (e.g., abstinence from animal-source food consumption for up to 240 d/yr in Ethiopia). Additional factors include the low productivity of dairy cows due to retention of unproductive animals in the herd for religious reasons in India and Nepal (Bhaskaran, 1996). Further, weak regulatory systems have fostered concerns about contamination of dairy products with pathogens, toxins (particularly aflatoxin), and chemicals such as pesticide residues and antibiotics (Grace et al., 2020). In addition, high volumes of variable quality and sometimes adulterated milk sold through informal marketing channels can account for up to 70% of the national production in some LMICs (Sinja et al., 2006; Grace et al., 2020).

The foregoing highlights the importance of increasing the productivity, affordability, accessibility, and safety of dairy products in LMICs. The papers presented in this special issue of the *Journal of Dairy Science* outline different strategies to improve these factors. These papers were presented at the MILK Symposium during the 2019 annual meeting of the American Dairy Science Association® in Cincinnati, Ohio, which was sponsored by the Feed the Future Innovation Lab for Livestock Systems (Gainesville, FL). The vision of the US Agency for International Development (USAID) and Bill and Melinda Gates-funded Feed the Future Innovation Lab for Livestock Systems at the University of Florida is to sustainably intensify livestock production to improve the nutrition, health, incomes, and livelihoods of the poor. Several of its 45 projects focus on improving dairy production in developing countries. In partnership with the International Livestock Research Institute (Nairobi, Kenya), several US universities, and over 40 foreign partners, the Innovation Lab manages and implements research for development projects in Kenya, Uganda, Nepal, Cambodia, Burkina Faso, Niger, Rwanda, and Ethiopia. A complementary project with similar dairy industry improvement goals at the University of Florida works in Sri Lanka.

This special issue begins with a general overview about the nutritional importance of milk (Givens, 2020) followed by several Innovation Lab and related project papers on strategies to improve dairy production and quality, milk safety, and milk consumption (Amenu et al., 2020; De Vries et al., 2020; Grace et al., 2020; Miller et al., 2020; Ndahetuye et al., 2020; Sah et al., 2020; Vyas et al., 2020). The special issue concludes with a paper on the sustainability of milk production in LMICs (Tricarico et al., 2020). The papers collectively show how strategic interventions can lead to marked improvements in dairy production in developing countries. These will ultimately contribute to meeting the growing global demand for milk and to achievement of the United Nations Sustainable Development Goals related to alleviation of hunger and poverty, improvement of education and employment, and environmental stewardship (United Nations, 2018).

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