509  The importance of milk in the diets of infants, pregnant women, adolescents and adults. D. I. Givens*, University of Reading, Reading, UK.

The different life stages give rise to important nutritional challenges some of which are related to increasingly aged populations in many Western societies. There is however, increasing evidence that diets during childhood and adolescence can affect health in later adulthood. For example, undernutrition in childhood can lead to stunted growth, which is associated with reduced cognitive ability and increased risk of chronic diseases and co-morbidities in adulthood. Despite recent worldwide improvements, stunting in sub-Saharan Africa remains about 40% and some countries have an even higher prevalence. Milk is a key food for reducing stunting with milk proteins having a crucial role. In some Western societies recent reductions in milk consumption have led to sub-optimal intakes of calcium and magnesium by teenage females in particular, at a time when bone growth is at its maximum and of iodine during pregnancy needed to ensure that supply/production of thyroid hormones to the fetus is adequate. It is of note that the concentration of some key nutrients, particularly iodine is influenced by the the iodine intake of the dairy cow. Low intakes of calcium is a particular concern since many populations are also of sub-optimal vitamin D status. This may already have had serious consequences in terms of bone development, which may not be apparent until later life. Recent meta-analyses show no evidence of increased risk of cardiovascular diseases from high consumption of milk and dairy foods but increasing evidence of a reduction in the risk of type 2 diabetes associated with fermented dairy foods, yogurt in particular. The recently updated reports from the World Cancer Research Fund International / American Institute for Cancer Research on the associations between dairy foods and various cancers provide further confidence that total dairy products and milk, are associated with a reduced risk of colorectal cancer and high intakes of milk/dairy are not associated with increased risk of breast cancer. This session aims to examine the role of dairy foods at key life stages in terms of their ability to moderate chronic disease risk.

Key Words: milk, dairy, health

510  Foodborne diseases from dairy products in developing countries: hazards and health implications. A. H. Havelaar*, D. Grace-Randolph1, and F. Wu1, 1University of Florida, Gainesville, FL, 2International Livestock Research Institute, Nairobi, Kenya, 3Michigan State University, East Lansing, MI.

Dairy products are an important source of animal proteins in developing countries, and increased consumption of these products by pregnant women and young children is advocated to reduce malnutrition and child stunting. However, the nutritional benefits of dairy products can be compromised by the presence of contaminants causing foodborne disease. These food safety risks are increased by frequent consumption of raw or inadequately heated dairy products. The World Health Organization published estimates of the global burden of foodborne disease in 2015, and attribution of this disease burden to specific food groups in 2017. It is estimated that each year, 600 million people fall ill because of foodborne disease, resulting in 435,000 deaths and a disease burden of 33 million disability adjusted life years (DALYs; equivalent to one healthy life year lost). Of this burden, 38% is attributed to animal-source foods (ASF), with 12% of the burden of ASF attributed to dairy products. The average global burden of dairy products is 20 DALYs per 100,000 population. The major contaminants in dairy are Mycobacterium bovis (highest burden in Africa), Campylobacter spp. (highest burden in Eastern Mediterranean), nontyphoidal Salmonella enterica (highest burden in Africa) and Brucella spp. (highest burden in Eastern Mediterranean). The burdens of Cryptosporidium spp., Shiga-toxin producing Escherichia coli and Toxoplasma gondii are low. Proper heating of dairy products would be effective in reducing these burdens substantially. The burden of chemical contaminants is less well documented. Adulteration is a potential problem, as illustrated by the melamine contamination incident in Chinese infant formula. Aflatoxin M1 (AFM1) is sometimes detected in milk in concentrations higher than maximum tolerable limits in the USA and Europe. AFM1, which cannot be destroyed by heating milk, is a metabolite of aflatoxin B1 (AFB1), a mycotoxin (fungal toxin) frequently found in corn, nuts, and the feed of dairy animals. However, the carcinogenic potential of AFM1 is significantly lower than that of AFB1 and the risk of liver cancer from current exposure levels to AFM1 is likely to be extremely low. There is limited evidence of an association between AFM1 and stunting, which requires further study. Dioxins cause a high disease burden specifically in Southeast Asia and several metals (lead, arsenic, methylmercury) each cause a global burden of 20–70 DALYs per 100,000. The contribution of dairy products to human exposure to these chemicals is unknown.

Key Words: dairy, foodborne disease, pathogen

511  Subclinical mastitis prevalence, causative pathogens and risk factors in small dairy holders linked to milk collection centers in Rwanda. J. B. Ndahutuye*,1,2, J. Twambazimana3, A. Nyman4, Y. Persson5, and R. Båge2, 1Division of Reproduction, Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden, 2College of Agriculture, Animal Sciences and Veterinary Medicine, University of Rwanda, Busogoro, Rwanda, 3National Veterinary Institute, Uppsala, Sweden, 4Vaxa Sverige, Stockholm, Sweden.

Milk production is prioritized in Rwanda as it represents an essential food source for many families, therefore, higher milk yields are desired. Subclinical mastitis (SCM) is one reason for low milk yield but SCM has not been well studied in Rwanda. The objective of this study was to evaluate prevalence, causative udder pathogens, and cow and herd risk factors associated with SCM in dairy cows linked to milk collection centers (MCC) in Rwanda. Screening with the California Mastitis Test (CMT) was done on 572 cows from 404 herds from 2 MCCs in each of 4 provinces. Milk from udder quarters with CMT score ≥ 3 (scale 1–5) was sampled for bacteriological analyses by culture and a final identification with matrix-assisted laser desorption ionization time of flight mass spectrometry. The prevalence of SCM was 37.3% at the quarter level and 62.0% at cow level. There was a significant (P ≤ 0.05) difference in SCM prevalence among the MCCs, with highest prevalence in the 2 MCCs in the northern province. Bacteria were isolated in 66.3% of the cultured milk samples, whereas culture-negative and contaminated samples were 30.7% and 2.99%, respectively. Non-aureus staphylococci (NAS) and S. aureus were the most prevalent pathogens, representing more than half of all bacteriological findings. Staphylococcus chromogenes and S. epidermidis were the most prevalent NAS identified. Beta lactamase production was present in 65.7%
of all staphylococci isolates. The risk factor analysis indicated that an increased stage of lactation, dirty udder and legs, no calf suckling the dam and not feeding concentrates were associated with increased odd ratio of SCM in cows. Absence of foremilk stripping was the only factor associated with *S. aureus* infection. High SCM prevalence could affect yield and milk quality at the MCC level. Identified pathogens suggest a possible high rate of within quarter or cow infection transmission and low cure rate against penicillin. Control of the identified risks factors and biosecurity by adjustments in practices, and farmer training could contribute to lowering SCM in Rwanda

**Key Words:** subclinical mastitis, California Mastitis Test (CMT)

### 512 A technology package for the control of mastitis in dairy animals at smallholder farmer level

K. Sah1, P. Karki1, R. Shrestha2, A. Adesogan3, and G. Dahl4, 1Heifer International Nepal, Kathmandu, Nepal, 2Himalayan College of Agricultural Sciences and Technology, Kathmandu, Nepal, 3Department of Animal Sciences, University of Florida, Gainesville, FL.

Dairy animals are an important source of income, food and nutritional security at the household level, and improvement in the production and productivity of dairy animals substantially improves the well-being of smallholder farmers. Like other developing countries, dairy animals are key for rural livelihoods in Nepal but often suffer from mastitis, a production disease causing economic losses to farmers, challenges to the dairy processing industry and possible health hazards to consumers. Studies show that the prevalence of sub-clinical mastitis in Africa and Asia exceeds 50%, threatening farmers, dairy processors and consumers. A study was done in Nepal by Heifer International Nepal to develop a technology package to control mastitis in dairy animals. This project was carried out with financial and technical support from the Livestock Systems Innovation Lab at the University of Florida, and in partnership with the Department of Livestock Services and Himalayan College of Agricultural Sciences and Technology. The technology package consisted of (1) identifying knowledge gaps; (2) developing good husbandry practices, including mastitis detection and control technologies; and (3) training of technicians and farmers. The package was applied in the mid-western region of Nepal. Six months after implementation, a reduction in sub-clinical mastitis prevalence was observed in dairy cows (55% at baseline to 28%, n = 432) and buffalo (78% at baseline to 18%, n = 216). These positive study outcomes strongly suggest that the mastitis technology package can be scaled among smallholder farmers across and beyond Nepal to control mastitis in dairy animals.

**Key Words:** dairy animal, subclinical mastitis, technology package

### 513 Interventions towards improving the microbiological quality of traditional yogurt in Borana pastoral communities, Ethiopia

K. Amenu1, M. Tiki2, K. Amdhun3, H. Desta3, G. Agga4, B. Wieland3, O. Kerro Degο5, D. Grace6, D. Hunduma7,8, H. Muhi El-Dine5, and S. Alonso3, 1Department of Microbiology, Immunology and Veterinary Public Health, College of Veterinary Medicine and Agriculture, Addis Ababa University, Bishoftu, Ethiopia, 2Institute of Leadership and Good Governance, Ethiopian Civil Service University, Addis Ababa, Ethiopia, 3International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia, 4USDA-ARS, Food Animal Environmental Systems Research Unit, Bowling Green, KY, 5Department of Animal Science, University of Tennessee, Knoxville, TN, 6International Livestock Research Institute (ILRI), Nairobi, Kenya, 7Department of Animal Sciences, College of Agriculture and Environmental Sciences, Arsi University, Asella, Ethiopia, 8International Centre for Agricultural Research in the Dry Areas (ICARDA), Amman, Jordan.

Dairy plays an important role in the diet of Borana pastoral communities of Ethiopia, but poor hygiene during milk production, handling and processing coupled with raw milk consumption are significant health risks for consumers. We conducted experiments to assess the effect of different practices on bacterial quality of traditional yogurt. In a field trial, we investigated the impact of using stainless-steel containers instead of traditional containers made of interwoven fibers on bacterial load and the cultural acceptability of the steel container for yogurt preparation. In a laboratory experiment, we assessed the effect of sanitizing milk containers with smoke from 3 tree species (*Olea europaea* ssp. *africana*, *Faurea speciosa* and *Terminalia brownii*), 2 milk containers (traditional vs. stainless steel) and 2 smoking methods (introducing the burning wood in the container vs. fumigation) on bacterial loads. The field trial showed that the bacterial loads of the yogurt prepared using traditional and stainless-steel milk containers did not differ (*P* < 0.05). Most of the informants appreciated the stainless-steel container because it could be easily sealed with a lid. However, they reported no desire to use it as substitute to the traditional container because (1) it becomes hot during the day and cold during the night, which accelerates souring of milk and (2) it does not have the traditional decorations. Moreover, 55.8% of the respondents indicated that yoghourt prepared using the traditional container had a better taste. The lab experiment showed that the traditional container (*P* < 0.001) and smoking by putting the burning wood inside the container (*P* = 0.013) reduced bacteria loads compared with the alternatives. Similarly, *Olea* tree species was more effective than others at reducing bacterial loads. Our results suggest that the use of stainless steel containers did not add value for the Borana pastoral communities as it did not reduce bacterial load of yogurt and the container acceptability among end-users was low.

**Key Words:** milk container sanitation, participatory experiment, traditional dairy processing

### 514 Effects of ration formulation on the performance of dairy animals in Nepal

B. Shrestha1 and A. Adesogan2, 1Heifer International Nepal, Hattiban, Lalitpur, Nepal, 2Florida University, Gainesville, FL.

Dairy is the most important livestock sub sector contributing almost 2-thirds of the livestock gross domestic product in Nepal. The prevalent dairy animal feeding approach is dependent primarily on locally available feed resources and it aims to fill the guts of animals without proper consideration of their nutrient requirements for various functions. The consequences are suboptimal performance and common occurrence of reproductive disorders in high yielding dairy cows and buffalo, with overall poor lifetime production. A study was carried out to examine effects of least cost ration formulation on the performance of dairy cattle and buffaloes. Twenty-six Jersey and Holstein cattle in early lactation of parity 1–4 and 30 Murrah buffaloes (parity 1–6) were randomly allocated to 2 groups after matching them for breed, parity, and stage of lactation in separate experiments. One group of cows or buffaloes in each experiment was fed a balanced ration formulated using a feeding support tool (phone app developed based on nutrient requirements of dairy animals from ICAR and the dairy NRC) for 8 weeks and the control group was fed a ration that typified farmers’ practice. The average initial milk yield of cattle in both groups was 9.30 kg/d. This increased to 9.96 kg/d during the experimental period in the treatment group, while the average yield for the control group remained unchanged (9.08 kg/d). The fitted ANCOVA model was significant with an estimated difference in yield of 0.994 kg/d. Similarly in buffaloes, the initial milk yields in treatment...
and control groups were 5.53 and 5.56 kg/d and these changed to 5.31 and 4.92 kg/d, respectively at the end of the experiment. The estimated increase in milk yield of buffaloes in the treatment versus control group was 0.415 kg/d. A survey of 100 farmers who participated in on-farm testing revealed that 94% of those who used the feeding support tool reported a 0.5 to 2 kg/d increase in milk yield on average with similar or reduced feeding costs. Therefore, using the feeding support tool is an effective strategy for enhancing milk production in Nepal.

**Key Words:** feeding support tool, dairy animal feeding system, least cost ration

### 515 Improving milk production on market-oriented dairy farms in Sri Lanka


Dairy is the most important sub-sector in the Sri Lankan livestock industry, because of the need to address a growing demand for fresh milk and milk products, and because of its potential influence on the rural economy. The USDA’s Food for Progress program awarded a 4-year Market-Oriented Dairy (MOD) project to International Executive Service Corps (IESC), a Washington, DC, not-for-profit organization. The objective of MOD is to support Sri Lanka’s dairy sector and catalyze sustainable growth by strengthening the dairy sector through better technological, financial, and management practices benefitting all stakeholders and consumers along the dairy value chain. The University of Florida (UF) is working with IESC as technical experts in conducting dairy value chain assessments, identifying gaps and challenges in dairy management practices, extension services, milk quality management standards and artificial insemination (AI) services. Assessment of the dairy value chain in 2018 identified a lack of good quality and quantity of feed, along with poor dairy management practices and ineffective extension services as major constraints in improving dairy productivity in Sri Lanka. In addition, a lack of national milk quality standards that are consistent with international benchmarks and inadequate cooling facilities are significant challenges to improving milk quality. The nutritional status of cows is not suitable for optimal reproductive performance, compromising the success of AI in Sri Lanka. Based on these findings we developed a dairy assessment tool and provided comprehensive training sessions targeting extension agents, veterinarians, and farmers to promote best practices in dairy management. Beyond training, however, industry support for standardization and monitoring of milk and feed quality are needed; providing opportunities for private investment to support the dairy industry. Similar opportunities are available for forage production and delivery to producers. The broader impact of the MOD project intervention is to reduce Sri Lanka’s dependency on imported milk and contribute toward the goal of safe, self-sufficient fresh milk.

**Key Words:** milk, child, growth and development

### 517 Sustainability of dairy production in developing countries

J. M. Tricarico* and E. Kebree#, 1Dairy Management Inc., Rosemont, IL, 2University of California, Davis, Davis, CA.

Sustainable milk production in developing countries must address food security and climate change mitigation simultaneously. Socioeconomic sustainability is paramount in developing countries where milk production and consumption represent a vehicle to improve human nutrition and health, as well as the potential for increased income, leading to improved livelihoods by subsistence farmers with limited access to markets. These benefits can only be achieved with judicious use of animal stocks and agricultural practices that do not exhaust available natural resources, which are often shared by regional farming communities. Milk and dairy foods provide balance and variety to the diet and make significant contributions to meeting the needs for calcium, magnesium, selenium, riboflavin, vitamin B12, and pantothenic acid (vitamin B5) in undernourished populations and especially children. Milk production in developing countries largely occurs in smallholder mixed crop-livestock systems where the animals may suffer from malnutrition leading to negligible or no milk production during several months of the year. Livestock are also valued for non-food functions such as draft, fuel (manure), store of capital and insurance against crop failure incentivizing the maintenance of large unproductive herds that place stress on feed (land) and water resources. Under these circumstances, sustainable intensification—increasing milk production from currently available resources—represents the single most important and practical strategy for improving the sustainability of milk production and consumption in developing countries. Improving the genetic potential of the animals, the availability of quality feed, and providing balanced nutrition are the most promising strategies to improve milk production and sustainability in developing countries. For example, the productivity gap for milk...
in Ethiopia is estimated at 4.5 billion L/year, which can be closed, in part, with balanced nutrition. Milk production in developing countries will be sustainable if it supplies more essential nutrients to under and malnourished populations while utilizing the natural resources available.

**Key Words:** sustainability, dairy, developing countries