Guide make up a greater percentage of the calories in the diet of Canadians than do foods from the Meat and Alternatives, Milk and Alternatives, or Vegetables and Fruits food groups. To counter the obesity epidemic, plant-based diets are often promoted as a solution. However, it is widely accepted that animal products supplement and complement a diet based on plant foods so that it is nutritionally adequate. Replacing some carbohydrate with high quality protein foods may have clinical benefits. The nutritional lens needs to be adjusted to focus on the dietary quality meat contributes to a plant-based diet.

Key Words: dietary patterns, dietary quality

MILK PROTEIN AND ENZYMES

0910 Intrinsic and extrinsic factors affecting milk yield and composition of camel milk in northern Eritrea. Y. N. Berhane*, *Uludag University, Bursa, Turkey.*

Although camel milk contributes rich dietary components to the people living in Eritrean lowlands, factors affecting its average daily yield and composition have not yet been studied. Hence, the objective of our study was to investigate effects of extrinsic factors (season) and intrinsic factors (stage of lactation and parity) on milk yield and its composition in camels kept under traditional management conditions in northern semiarid areas of Eritrea. We collected 300 random milk samples from January to October in 2013, 30 samples each month. The analysis of milk composition was done using the lacto scan milk analyzer, an automated milk analyzer system, and the obtained data were analyzed using the general linear model on SPSS 18 software. The average daily yield of milk and compositions of fats, protein, and lactose were 3.78 L, 2.43%, 2.71%, and 4.8%, respectively. Stage of lactation, parity, and season of the year significantly influenced ($P < 0.05$) daily milk yield and composition of fats and protein. The percentage composition of lactose remained unaffected by any variables considered. The highest average daily milk yield was recorded at the second month of lactation (4.04 ± 0.10 L), whereas the least was after 8 mo of lactation. The daily milk yield was significantly higher at the third month. The percentage composition of fat and protein were also at their peak during the first 3 mo of lactation period (3.21 ± 0.14 and 2.76 ± 0.11%, respectively). Similarly, the highest average daily milk yield and percentage composition of protein, fat, and dry matter were recorded from camels of 3rd parity (4.43 ± 0.2 L, 5.11 ± 0.51, and 3.19 ± 0.22%, respectively). This study revealed that camels are a reliable source of milk with persistent yield and composition throughout most of the period of lactation. Effective herd management, proper selection and culling, and provision of supplemental feed during the dry seasons may contribute to high quality camel milk in the region.

Key Words: camel, Eritrea, milk composition, milk yield, extrinsic and intrinsic factors

0911 Effect of lactoferrin hydrolysates on cytokine expression in Raw264.7 cells. Y. W. Park*[1], J. Y. Son[2], G. Renchinkhand[2], S. H. Paik[3], and M. S. Nam[2], *[1]Fort Valley State University, Fort Valley, GA, [2]Chungnam National University, Daejeon, The Republic of Korea, [3]Cheonan Yonam College, Cheonan, The Republic of Korea*.

Lactoferrin (LF) is an iron-binding glycoprotein which is present in colostrum, milk, and other body secretions. LF is associated with human infants' inflammatory and immune responses. The objective of this study was to determine the effects of alkaline protease generated lactoferrin hydrolysates (LH) on immunomodulatory activities of nitric oxide (NO) production and cytokines production, including anti-inflammatory cytokines [interleukin(IL)-4], pro-inflammatory cytokines (interleukin-6, tumor necrosis factor-α, interferon-γ), Th2 cytokines (interleukin-4 or interleukin-6), and Th1 cytokines [tumor necrosis factor (TNF)-α, interferon (IFN)-γ] in immune cells. The presence of LH was confirmed by SDS-PAGE and HPLC analyses. The LH above 10 kDa and below 10 kDa were isolated from the extracted LH using 10 kDa cut-off centricon. Raw264.7 cells were treated with 3 different LH concentrations (1, 50, 100 μg/ml) for three types of LH (whole, above and below 10 kDa) treatments at 37°C for 3 hr, and then the culture supernatants were quantified by TNF-α and IL-1β ELISA kit. Cytokine expression levels in Raw264.7 cells were analyzed by reverse transcription-polymerase chain reaction (RT-PCR). Results showed that 1 μg/ml of three types of LH treatments produced 1500–2,000 ng/ml TNF-α, whereas the positive LPS (lipopolysaccharide) and negative controls produced 2450 and 1000 ng/ml TNF-α, respectively. The 50 μg/ml treatments of the three types of LH produced about 20–28 ng/ml IL-1β at 3, 6, 9 h, while the negative control had 7 ng/ml. TNF-α expression was decreased dose-dependently by the 3 LH groups, while none of the LH treated groups affected IL-6. The mRNA expression of IL-13 appeared in all LH concentrations. In RAW264.7 cells treated with 1, 50, 100 μg/ml for 3 h, the mRNA expression induced a remarkable increase in nitric oxide synthesis (INOS) with dose dependent manner. NO was secreted dose-dependently from macrophages which were activated by all concentrations of the 3 LH treated groups. The results of RT-PCR revealed that LH caused INOS and inhibited the production of TNF-α in Raw264.7 cells. It was concluded that lactoferrin hydrolysates had immunomodulating effects on anti-, pro-inflammatory, and anti-allergic reactions.

Key Words: lactoferrin hydrolysates, cytokines, Raw264.7 cells

0912 Three new bovine α_s-CN phosphorylation isoforms reveal different phosphorylation pathways. Z. H. Fang[*1,2,3], M. H. P. W. Visker[3], G. Miranda[1,2], A. Delacroix-Buchet[1], H. Bovenhuis[3], and P. Martin[4], *[1]INRA, UMR1313 GABI, Jouy-en-Josas, France, [2]Agroparistech, UMR 1313, GABI, Jouy-en-Josas, France, [3]Animal Breeding and Genomics Centre, Wageningen University, Wageningen, Netherlands, [4]UMR1313 Gabi, INRA, AgroParisTech, Université Paris-Saclay, Jouy-en-Josas, France*.

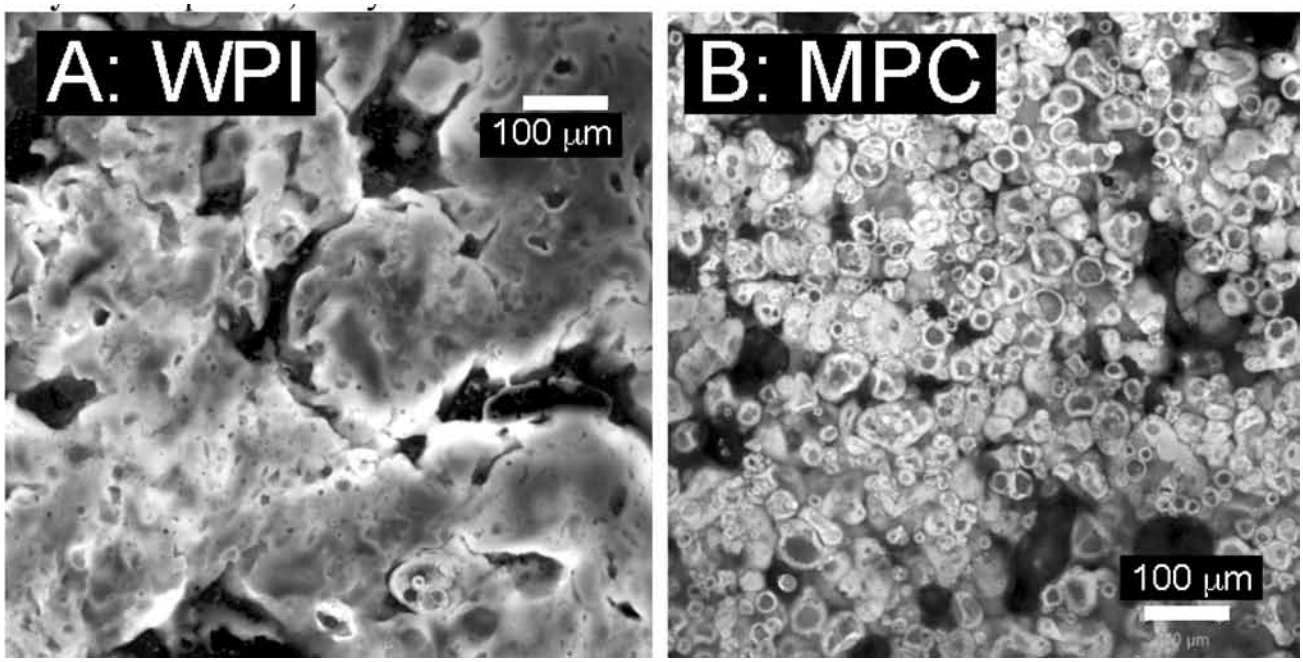
Casein (CN) phosphorylation is an important post-translational modification, and it is one of the key factors responsible for constructing and stabilizing casein micelles. Variation in phosphorylation degree of α_s-CN is of great interest because it is suggested to affect milk technological properties. Our objective was to investigate the variation in phosphorylation degree of α_s-CN among milk of individual cows and to explore relationships among different phosphorylation isoforms of α_s-CN. For this purpose, we analyzed morning milk samples from 529 French Montbéliarde cows using liquid chromatography coupled with electrospray ionization mass spectrometry (LC/ESI-MS). We detected three new phosphorylation isoforms: α_{s2}-CN-9P, -14P, and -15P in bovine milk, in addition to the known isoforms α_{s1}-CN-8P and -9P, and α_{s2}-CN-10P, -11P, -12P, and -13P. The relative concentrations of each α_s-CN phosphorylation isoform varied considerably among milk of individual cows (coefficient of variation $\geq$ 8). Furthermore, the phenotypic correlations and hierarchical clustering suggest two regulatory systems for the phosphorylation of α_s-CN: one responsible for isoforms with lower levels of phosphorylation (α_{s1}-CN-8P, α_{s2}-CN-10P and -11P), and the other responsible for isoforms with higher levels of phosphorylation (α_{s1}-CN-9P, α_{s2}-CN-12P, -13P and -14P). Identifying all phosphorylation sites of α_{s2}-CN and investigating the genetic background of different α_{s2}-CN phosphorylation isoforms may provide further insight into the phosphorylation mechanism of caseins.

Key Words: phosphorylation, casein, milk protein composition, LC/ESI-MS

0913 Hardening and microstructure of high protein nutrition bars made using whey protein isolate or milk protein concentrate. S. K. Hassan[1] and D. J. McMahon[*2], *[1]College of Education, Al-Qadisiya University, Al-Qadisiya- Diwaniya, Iraq, [2]Western Dairy Center, Utah State University, Logan*.

High-protein nutrition (HPN) bars (especially those containing > 30% protein) became hard during storage and have a limited shelf life, resulting in disappointment by consumers or loss of product as older products are discarded. The effect of different components on hardening of HPN bars was studied in bars containing 34% (wt/wt) whey protein isolate (WPI) or milk protein concentrate (MPC) powder, along with either sorbitol syrup or glycerol, and vegetable shortening or cocoa butter. The bars were stored at 20°C and 35°C and monitored for changes in hardness (measured using a penetration test), water activity, state of water and denaturation of whey proteins (measured using differential scanning calorimetry), and microstructure using confocal scanning laser microscopy. Substituting MPC for WPI made the bars brittle and crumbly. Using glycerol initially made bars softer but accelerated

Fig 0913.



hardening. Cocoa butter increased bar hardness because of its higher solid to liquid content. Most water (~99%) in HPN bars made using sorbitol syrup is present as bound water, with ~0.9% as intermediate water and ~0.1% as bulk water. During storage, bound water increased ~0.02 g/100 g of solids while intermediate water decreased, suggesting changes in state of water taking place at protein surfaces. During storage, there were changes in protein conformation indicated by an increase (~4°C) in heat denaturation temperature of β-lactoglobulin and α-lactalbumin and a 15 to 40% decrease in denaturation enthalpy. In bars made using WPI, the protein was present as a continuous network (see Figure A) while in bars made using MPC the protein remained in separate particles of protein powder dispersed throughout the sorbitol-water cosolvent mixture (see Figure B). It is proposed that hardening of HPN bars is a result of interactions between the cosolvents and the protein surface and not because of a phase separation between protein and cosolvents as was previously hypothesized.

Key Words: protein, whey microstructure

0914 Effect of casein non-phosphopeptides on the development of rat muscle analyzed using computed tomography (CT) scanning technology.

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About 2% of the population of age 50 suffers from sarcopenia, and the proportion is more than 50% after the age of 80. Sarcopenia may lead to physical weakness and reduced balance and mobility, which in turn have possible metabolic effects such as diabetes, arthritis, osteoporosis, and heart diseases. The leucine-rich whey protein α-lactalbumin has been found to counteract the muscle loss caused by sarcopenia. Casein non-phosphopeptide (CNPP) is a by-product from casein phosphopeptide production and is rich in leucine. The objective of this study was to investigate the effect of CNPP on the muscle development of healthy rats. Ten 32-wk-old male rats were fed one of the four dosage levels of CNPP or α-lactalbumin (high dose, 10 g/kg/d; moderate dose, 5 g/kg/d; low dose, 2.5 g/kg/d; and blank, 0 g/kg/d) for 50 d. Each feeding group was divided into two exercise groups: resistive exercise group (REG) and no exercise group (NEG). The resistive exercise consisted of three sets of 5 min of stair climbing with 1 min intervals daily. At 0, 15, 25, 35, and 50 d of feeding, rats were anesthetized and their cross-sectional body images were obtained using a transverse spiral CT scanner. Muscle groups were identified based on anatomical features. The areas of these muscle groups in the obtained images were determined using the CT software. The blood levels of growth hormone, insulin, and testosterone were determined using assay kits. Results were analyzed statistically using SPSS software. The results showed that the cross-sectional area of the trunk, back muscle group, and left upper limb muscle roots of the REG rats fed the moderate dose CNPP for 50 d increased significantly ($P < 0.05$). The cross-sectional area of the trunk and lumbar muscle group of the REG rats fed the high dose CNPP for 50 d also increased significantly ($P < 0.05$). Furthermore, the cross-sectional area of the trunk, β scapular muscles, and left upper limb muscle roots of the NEG rats fed the moderate dose CNPP for 50 d increased significantly ($P < 0.05$). In both CNPP-fed REG and NEG groups, the blood levels of growth hormone, insulin, and testosterone increased significantly after feeding for 50 d compared to those on Day 0 ($P < 0.05$). Our studies have demonstrated that the leucine-rich CNPP stimulates the synthesis of certain rat muscles and increases the blood levels of insulin, growth hormone, and testosterone.

Key Words: casein non-phosphopeptide, sarcopenia, CT scanning

Table 0914. Table 1 Increases in the cross-sectional area of different muscle groups in transverse spiral CT scanning images after 50 days of feeding.

		REG				NEG			
	Protein fed	Blank (cm^2)	Low dose (cm^2)	Moderate dose (cm^2)	High dose (cm^2)	Blank (cm^2)	Low dose (cm^2)	Moderate dose (cm^2)	High dose (cm^2)
Trunk	CNPP	6.87±0.65^a	7.97±0.56^b	6.20±0.48^a	8.58±0.88^c	7.01±0.60^a	7.47±0.42^a	8.37±0.76^b	7.31±0.78^a
Trunk	α-Lactalbumin	5.16±1.22^a	4.50±0.86^b	3.67±0.64^c	5.58±0.95^a	8.14±0.68^a	3.93±0.40^c	5.74±0.54^b	7.60±0.70^a
Lumbar muscles	CNPP	1.46±0.65^a	1.50±0.52^a	1.47±0.74^a	2.26±0.66^b	2.47±0.25^a	1.68±0.24^b	2.12±0.54^a	1.81±0.44^b
Lumbar muscles	α-Lactalbumin	0.26±0.18^a	0.73±0.09^b	0.28±0.14^a	1.47±0.21^c	1.20±0.20^a	0.84±0.22^b	0.68±0.42^c	0.66±0.32^c
Back muscles	CNPP	0.70±0.16^a	1.06±0.18^b	0.66±0.21^a	0.80±0.14^a	0.74±0.16^a	0.32±0.18^b	0.86±0.20^a	0.83±0.22^a
Back muscles	α-Lactalbumin	-0.28±0.12^a	0.50±0.15^b	-0.1±0.09^a	0.41±0.18^b	0.15±0.18^a	0.37±0.15^b	0.32±0.12^b	0.48±0.14^b
Beta scapular muscles	CNPP	0.87±0.11^a	0.88±0.15^a	1.05±0.10^b	0.77±0.07^a	1.06±0.42^a	1.22±0.28^{ab}	1.31±0.50^b	1.14±0.42^a
Beta scapular muscles	α-Lactalbumin	0.53±0.12^a	1.10±0.09^b	1.52±0.14^c	1.20±0.16^b	1.16±0.30^a	1.66±0.26^{bc}	1.42±0.18^b	1.72±0.16^c
Left upper limb muscle roots	CNPP	0.54±0.14^a	0.88±0.16^c	0.86±0.12^c	0.54±0.12^b	0.41±0.16^a	0.71±0.10^b	0.79±0.22^b	0.68±0.20^b
Left upper limb muscle roots	α-Lactalbumin	0.14±0.12^a	0.35±0.15^b	0.41±0.22^c	0.35±0.28^b	0.16±0.10^a	0.28±0.14^b	0.16±0.08^a	0.45±0.15^c

n=5, Different letters in each muscle group (a-c) indicate significant differences ($P < 0.05$).

0915 Physico-chemical properties and antioxidant efficacy of whey protein isolate and casein hydrolyzate stabilized nano-vesicular vehicle systems containing curcumin. Z. Z. Haque*and S. Mukherjee, *Food Science, Nutrition and Health Promotion, Mississippi State University, Mississippi State*.

Development of stable nano-emulsion systems, designed for efficient delivery of hyper-active natural antioxidants, nutraceuticals, and other bioactive compounds is crucial for effective enhancement of dairy product shelf-life as well as to alleviate the detrimental biological consequences caused by the reactive oxygen species. This study investigated the physicochemical and antioxidant properties of a nanoemulsion system, developed as nano-vesicular vehicles (NVVs) for efficient delivery of curcumin (CU), a highly potent, generally recognized as safe (GRAS) antioxidant. Coarse emulsions were first produced by dispersing whey protein isolate (WPI) (1% w/v, primary emulsifier), tween-20 (20% w/v of WPI, secondary emulsifier), chymotryptic hydrolyzate of casein (CH) (1:50 w/w of WPI), and CU (0.22% w/v) in 200 mM phosphate buffer with a pH of 8.0 (the continuous phase) for 3 h with gentle stirring at 22°C. The NVVs were generated by subjecting the coarse emulsion to single-pass ultra-high-pressure homogenization (UHPH) at 140 and 210 MPa. Physico-chemical and antioxidative properties of the CU-loaded-NVVs containing CH (CU+CH-NVVs) were analyzed and compared to the NVVs without CH (CU-NVVs) for 16 d of storage at 4°C. Increasing the trace amount of CH resulted in a significant enhancement ($P < 0.05$) of both short- and long-term antioxidative properties [antioxidant activity (AA) and persistence (AP), respectively], in all CU+CH-NVVs throughout the study compared to CU-NVVs. The CU+CH-NVVs generated using 210 MPa showed 497 and 567% enhancement of AA and AP, respectively, relative to the CU-NVVs on the 16th day of storage. The former also showed 6222 and 11278% enhancement of AA and AP compared to the control (buffer alone). The CU+CH-NVVs generated at 210 MPa exhibited a considerable (7.4%) reduction in mean globular particle diameter as well as a substantial increase (17%) in zeta potential compared to the CU-NVVs formulated using the same UHPH at the final day of storage, indicating the efficacy of even a minute quantity of CH to remarkably enhance the stability of NVVs.

Key Words: nanoemulsion, neutraceutical, free radical

MILK SYMPOSIUM: MARKETING MILK FOR ENTREPRENEURIAL AND BIG BUSINESS VALUE

0916 Get in the driver's seat: Marketing milk and dairy products to today's and tomorrow's consumers. D. M. Berry*, *Dairy & Food Communications, Inc., Chicago, IL*.

Who buys a head of iceberg lettuce anymore when pre-washed, trimmed lettuce blends are readily available? It's the same person who buys a gallon of the white stuff and a chunk of cheddar. It's not the consumer—today's consumer–who grew up with more than 87,000 possible Starbucks combinations to create a customized drink. Millennials and their offspring are today's and tomorrow's consumers, demographics with unprecedented expectations of the food supply chain. They want customization, simplicity, and transparency but at the same time demand convenience, deliciousness, and portability. According to the International Food Information Council Foundation's 2015 Food and Health Survey, compared to the general U.S. population, Millennials have differing opinions on traditional eating habits, usage of resources and information for staying healthy, and even on the value of some nutrients. Understanding these views is paramount for dairy brands to thrive. According to the International Dairy-Deli-Bakery Association, the food retail world is changing, and the products and the players must change in tandem. Traditional food retailers are the most challenged, with data suggesting they will experience a 9% drop in market share (from 71% to 62%) over the next 10 yr as non-traditional channels like fresh formats and online retailers gain 38% of the food market. Traditional supermarkets that want to survive are responding to the changing retail channel landscape by featuring full-service restaurants, smaller formats, and Millennial-focused products and services. In 2014, e-commerce sales for consumables were $24.4 billion, an increase of 13.5% from 2013. Online purchases of foods and beverages are projected to almost quadruple between 2015 and 2020, to $49 billion, representing 4.5% of all food retail sales. When it comes to dairy, deli, and bakery, as well as prepared foods, specialty cheese, and specialty meats, the six fresh parameter departments in the traditional supermarket, consumers continue to appreciate the in-person experience. It's no wonder that the greatest percentage of increase in store count has come from channels outside of traditional food, drug, and mass-merchandising formats, including convenience stores, warehouse clubs, and dollar stores. Stores that focus on fresh foods, in particular single-serve options and convenience, invite consumers inside. And once inside, they often buy more than they really intended. Dairy foods manufacturers must make sure they are competing in this space.

Key Words: Millennials, innovation, consumer