concentrations ($P < 0.05$) of C12:0 and the CLA C18:2 c9, t11; and higher ($P < 0.05$) concentrations of C18:0. The C14:0 content was higher ($P < 0.05$) in the muscle of bulls fed NSB, compared to those receiving GSB. The concentration of C18:1 *trans* isomers were higher ($P < 0.05$) in the muscle of bulls fed GSB compared to those fed ESB and NSB. On the other hand, C18:1 c9 content in the muscle of bulls fed GSB was lower ($P < 0.05$) compared to the muscle of bulls fed the other diets. LD muscle of bulls fed soybean diets, regardless of processing, had greater concentrations of saturated fatty acids. Polyunsaturated fatty acid content was lower ($P < 0.05$) when bulls were fed ESB. Gene expression of *PPARA* and *PPARG* was not affected by diet ($P > 0.05$). However, expression of *SREBF1* was greater ($P < 0.05$) in the muscle of bulls fed ESB. In conclusion, extrusion of soybean contributes to the greater biohydrogenation of polyunsaturated fatty acids and consequently greater expression of the gene *SREBF1*. The use of ground or extruded soybean does not increase CLA C18:2 c9, t11 content in beef cattle muscle.

Key Words: CLA, extruded soybean, *PPAR*, *SREBF1*

0905 Heat shock protein expression differs in 14 d aged longissimus lumborum in agreement with Warner-Bratzler shear force values. N. E. Ineck*, R. G. Christensen, S. M. Quarnberg, J. McClellan, J. F. Legako, and K. J. Thornton, *Utah State University, Logan*.

Despite similar production practices, beef cattle exhibit undesirable variation in the rate and extent of postmortem proteolysis lending to inconsistencies in tenderness. The objective of this study was to determine whether heat shock proteins (HSP) play a role in postmortem proteolysis and thus, development of tenderness. To address this, HSP expression was determined in the longissimus lumborum after 14 d of aging. A total of 32 samples were placed into either a more tender (MT; $n = 16$) or less tender (LT; $n = 16$) group based on previous Warner-Bratzler shear force (WBSF) values. Western blot analyses were then completed to determine expression of two different HSP: HSPβ1 and HSP70. Statistics were completed using Proc MIXED in SAS to determine whether HSP expression varied between MT and LT samples; the model included tenderness as a fixed effect and gel and sample as random effects. Spearman-Pearson correlations were also completed in SAS to determine whether WBSF value and HSP expression were related. The two tenderness groups had different ($P < 0.001$) WBSF values; the MT group had an average WBSF value of 1.9 kg, while the less tender group had an average WBSF value of 5.5 kg. Less tender samples showed increases ($P = 0.03$) in HSPβ1 when compared to the MT samples. Furthermore, there was a correlation ($R = 0.5238$, $P = 0.008$) between WBSF value and HSPβ1 expression. No differences ($P = 0.49$) in HSP70 expression were observed between the MT and LT groups. There was no ($R = 0.031$, $P = 0.89$) correlation identified between WBSF values and HSP70 expression. These data demonstrate that HSPβ1 expression in meat samples from the longissimus lumborum after 14 d aging may play a role in postmortem proteolysis, and thus development of tenderness. Further research is needed to improve our understanding of how HSP are involved in the postmortem proteolysis process.

Key Words: heat shock proteins, tenderness, Warner-Bratzler shear force

MEAT SCIENCE AND MUSCLE BIOLOGY SYMPOSIUM: SCIENCE OF RED MEAT CONSUMPTION

0906 Beef's role in a healthy diet. J. N. Martin*, D. R. Woerner, R. Delmore, K. E. Belk, and J. D. Tatum, *Colorado State University, Fort Collins*.

Although red meat has long been established as a tremendous source of essential nutrients, its posed contributions to heart disease, obesity, and various cancers have resulted in growing criticism of its role in the diet. This widespread criticism and posited associations to negative health outcomes have fostered an overall decrease in the consumption of red meats in the U.S. over the past several decades. Although this decrease hasn't resulted in overt and direct improvements to human health, its absence has highlighted the vital nutritional role of lean, red meat in the diet. Concurrently, the entirety of the meat industry has steadfastly pursued investigating—and further, communicating—the nutritional profile and health value of red meats. A noteworthy example of efforts to demonstrate the nutritional advancement of red meats has been the remarkable progress on reducing the total available fat in consumed red meat products. Through targeted efforts in animal husbandry and processing innovation, the meat industry has reduced the total fat available from red meats by up to 70% in the past three decades. Furthermore, multiple industry efforts have addressed concerns regarding the fatty acid profile of red meats by demonstrating the relatively high proportion of unsaturated fatty acids and the cardiovascular neutrality of certain saturated fatty acids (i.e., stearic acid) in red meats. Likewise, although the value of red meat proteins has been long established, recent investigations of their role in weight loss and weight maintenance have highlighted their beneficial contributions to the diet and long-term health. Similarly, the exclusion of red meats in certain dietary patterns has been demonstrated to exacerbate iron deficiency and sarcopenia. Overall, the totality of data regarding the nutritional profile of red meat suggests that criticisms of its inclusion in dietary recommendations are unwarranted. Instead, the body of evidence suggests that negative health outcomes are complex, yet the inclusion of lean, red meats in a balanced diet can promote health and well-being.

Key Words: health, nutrition, red meat

0907 How certain can we be about the association of meat consumption and cancer? D. M. Klurfeld*, *USDA Agricultural Research Service, Beltsville, MD*.

The recent evaluation from the World Health Organization's International Agency for Research on Cancer (IARC) Working Group 114 concluded that processed meat consumption is a definite carcinogen in humans and red meat is probably carcinogenic. These were expert opinions of the majority of members of the group who evaluated the evidence they deemed most convincing. Most of the data that drove these two decisions were epidemiological studies, which are limited in their ability to distinguish causation from association. Animal studies do not support the conclusions and mechanistic studies are not convincing. Importantly, there are two large intervention studies in humans that were published but were not taken into consideration. These studies reduced meat intake significantly, as part of an overall dietary pattern, but that reduction had no effect at all on development of either colon polyps or cancer. Schemes for evaluating the totality of evidence to establish causality have been in the literature for 50 yr but were not used by IARC. In addition, no systematic review or meta-analysis was done, both of which have become the standard for such comparisons. Weaknesses inherent in evaluating long-term intake of any foods in observational studies should preclude using such data as the sole or primary determinant of causality in relation to health. It has been demonstrated conclusively that the food frequency questionnaire used to estimate meat intake in those studies is not able to quantify the amount of protein consumed. Statistical adjustment for confounders and covariates differed from study to study making combined analysis problematic. Finally, lack of registration of most observational studies without clear designation of the hypotheses to be studied and the numerous associations reported force the conclusion that any findings from them need to be accorded the higher statistical threshold that should be required of secondary results. A convincing argument can be easily defended that we do not have enough valid data to classify the carcinogenicity of red or processed meat for humans.

Key Words: red meat, processed meat, cancer, health, human nutrition

0908 The role of red and processed meat in colorectal cancer development: A perspective. S. De Smet*, *Ghent University, Melle, Belgium*.

Red and processed meat provide high biological value proteins and important micronutrients, but at the same time there is increasing epidemiologic evidence for an association between red and processed meat consumption and the risk to develop several chronic diseases. With respect to colorectal cancer, meta-analyses have reported a 15–20% increased risk of colorectal cancer per 100 g per day of red meat and per 50 g per day of processed meat consumption. A working group of IARC recently assessed the carcinogenicity of red and processed meat consumption through an elaborate evaluation of epidemiologic, animal, and mechanistic studies. Taking into account the amount of data, the nature and quality of the studies, and the extent to which chance, bias, and confounding from other dietary and lifestyle factors can be ruled out, it was concluded from the epidemiologic studies that there is sufficient evidence in human beings for the carcinogenicity of the consumption of processed meat, and limited evidence for red meat. Inadequate evidence was found in experimental animals, but the mechanistic evidence for carcinogenicity in the digestive tract was assessed as strong for red meat and moderate for processed meat. For genotoxicity and oxidative stress, evidence was considered moderate. Substantial supporting mechanistic evidence is available for multiple meat components (N-nitroso-compounds, haem iron, and heterocyclic aromatic amines). Taking this together, the IARC working group classified processed meat as "carcinogenic to humans" and red meat as "probably carcinogenic to humans.. This classification has unfortunately frequently been misinterpreted and has led to polarized and scientifically incorrect statements in the media. However, it should be realized that the IARC assessment was a hazard analysis according to established procedures and was not a full risk assessment, nor was it intended to make dietary recommendations. The question remains whether nutrition authorities will adapt their advice on the role of meat in a healthy diet based on this report. This is evidently a concern for the meat industry. On the other hand, insight into the mechanisms of the association between meat consumption and diseases offers opportunities for mitigation, as was already shown for the use of calcium. More research is needed on the mechanisms and on strategies to improve the composition, processing, and heating of meat, allowing for reduction of the harmful effects. Even more important, it is believed that the interaction of meat with non-meat food ingredients in dietary patterns should be investigated.

Key Words: colorectal cancer, processed meat, red meat

0909 Is there a role for meat in a plant-based diet? M. A. Binnie*, *Canadian Pork Council, London, ON, Canada*.

Many North Americans are overfed and undernourished, resulting in significant negative health consequences. Obesity is of global concern, with rates tripling in Canada in one generation. Dietary patterns have shifted away from fresh and minimally processed foods to include alarming amounts of added sugars and ultra-processed foods. In the U.S., added sugars in ultra-processed foods (21.1% of calories) was eightfold higher than in processed foods (2.4%) and fivefold higher than in unprocessed or minimally processed foods and processed culinary ingredients grouped together (3.7%). Similarly, 22% of calories in the average Canadian diet come from foods that provide little or no nutritional value. Foods not included in Canada's Food

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