Camel Milk: Potential Health Benefits

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INTRODUCTION

I continue to review the common claims made relating to the health benefits of camel milk and here I identify the most significant of those claims, critically evaluate them, and provide the solid scientific support for these claims. (If, in fact, it exists.) The references listed in the body of this document – over 400 in total are available – appear in order of year of publication. The bibliography for this document lists all references in alphabetical order.

Note: Due to a demanding travel schedule it has been difficult for me to get this completed to my satisfaction. Please consider this a <u>draft</u>, and I will continue to refine, review and complete on my return from Nashville. We can certainly speak about it today (afternoon your time), or face-to-face next week.

OVERVIEW OF CURRENT CLAIMS AND BREAKDOWN INTO GROUPS

Nomadic cultures have been drinking milk from camels for thousands of years. Camels can survive, travel and thrive with little water, and in areas where horses and cows could not. This has lead some to conclude that camel milk is "special", offers unique benefits and is a better alternative to cow and other milk options such as cow, goat, sheep, almond, soy and coconut milk. Although camel milk has long been available in North Africa and the Middle East, camel milk is relative recent entry to Western markets.

Camel milk has also been touted as a treatment for a very wide range of diseases and conditions. The troubling aspect of most of these claims is that present camel milk as a magical elixir and cure-all drink. Attached is a comprehensive list of published papers on specific health benefits of camel milk consumption. I am working through these and reviewing them for quality and significance.

There is unquestionably some very encouraging research on the health benefits of camel milk, but unfortunately, much of published science is poor quality, incomplete science, or based on anecdotal evidence. For example, there is a 2005 publication in the International Journal of Human Development, citing anecdotal evidence of improvements in young autistic patients who switched from cow's milk to camel's milk. Similarly, there is a small study of eight children with food allergies published in the Israeli Medical Association Journal reporting that camel's milk can help subjects overcome severe (milk-related) food allergies. While both studies are encouraging initial reports, they do not "prove" benefit, but rather, they provoke interest and hint at the need for further – better controlled – study.

What is certain, however, is that camel milk is nutritionally different from other milks. Therefore, claims such as the following, made about human breast milk, are scientifically sound and can be made about camel milk: "… a complex and rich source of nutrition containing

thousands of components, of which only a handful are identified and understood. Camel milk is a life sustaining fluid with the potential to promote development and protect against infection." (See: www.medolac.com.)

There is no question that camels possess unique, powerful immune-system components and that these are contained in their milk. These MAY offer benefits to individuals with disorders such as diabetes and autism. Here are how the current publications break down, and I will continue to review and provide you with an update.

I have done much more and it is available to include in this document, but I need to review and evaluate before inclusion. As you are aware, there is an extensive, but largely unsubstantiated literature on camel milk. An extensive conclusions section will follow.

Diabetes

There are 30 or more publications that deal specifically with camel milk and diabetes. These include the following: Agrawal, Beniwal et al. 2005, Agrawal, Budania et al. 2007, Agrawal, Saran et al. 2007, Agrawal, Dogra et al. 2009, Mohamad, Zekry et al. 2009, Sboui, Khorchani et al. 2010, Agrawal, Jain et al. 2011, Agrawal, Sharma et al. 2011, Badr, Mohany et al. 2011, Badr 2012, Badr, Badr et al. 2012, Malik, Al-Senaidy et al. 2012, Agrawal, Tantia et al. 2013, Badr 2013, Cardoso, Ponte et al. 2013, Ebaid, Ahmed et al. 2013, Abdel-Salam 2014, Arab, Salama et al. 2014, Bhat, Kanga et al. 2014, Ebaid 2014, Korish 2014, Ajarem, Allam et al. 2015, Ebaid, Abdel-Salam et al. 2015, Ejtahed, Niasari Naslaji et al. 2015, Korish, Abdel Gader et al. 2015, Manaer, Yu et al. 2015, Meena, Rajput et al. 2016, Mihic, Rainkie et al. 2016, Mohanty, Mohapatra et al. 2016.

Allergy Related References

See: Restani, Gaiaschi et al. 1999, Restani, Beretta et al. 2002, Katz, Goldberg et al. 2008, Al-Hammadi, El-Hassan et al. 2010, Ehlayel, Bener et al. 2011, Ehlayel, Hazeima et al. 2011, Cardoso, Ponte et al. 2013, Zibaee, Hosseini et al. 2015.

Cancer-Related References

Numerous references and some of considerable interest. See: McKnight, Burdon et al. 1992, Rahbarizadeh, Rasaee et al. 2004, Rahbarizadeh, Rasaee et al. 2005, Mohamad, Zekry et al. 2009, Liao, Du et al. 2010, Salwa and Lina 2010, Badr, Badr et al. 2012, Korashy, El Gendy et al. 2012, Korashy, Maayah et al. 2012, Habib, Ibrahim et al. 2013, Alhaider, Abdel Gader et al. 2014, Hasson, Al-Busaidi et al. 2015, Kanwar, Roy et al. 2015, Maswadeh, Aljarbou et al. 2015, Maswadeh, Aljarbou et al. 2015, Mohamed, Schaalan et al. 2015, Ahamad, Raish et al. 2016, Ben-Arye, Samuels et al. 2016, Mihic, Rainkie et al. 2016, Mohanty, Mohapatra et al. 2016, Romli, Abu et al. 2016.

Infection-Related References

Although some of these are of peripheral interest, there are also some encouraging findings. There is more solid evidence in this area than in any other. See: Angrisani 1962, Krupenko, Bailarov et al. 1973, Murray, Murray et al. 1980, Jezek, Kriz et al. 1983, Almer 1985, Barbour, Nabbut et al. 1985, Ramadan, el Hassan et al. 1987, Hiepe 1988, Elamin, Elias et al. 1992, Radwan, Bekairi et al. 1992, Abdurahman 1995, Abdurahman, Agab et al. 1995, Radwan, Bekairi et al. 1995, Abdurahman 1996, Khujneri and Qureshi 1998, Bekele and Molla 2001, Younan, Ali et al. 2001, Guliye, Van Creveld et al. 2002, Shaalan, Memish et al. 2002, Gustafsson, Kacskovics et al. 2005, Maghraby, Mohamed et al. 2005, Schelling, Daoud et al. 2005, Younan, Estoepangestie et al. 2005, Al-Moslih, Perkins et al. 2007, Redwan el and Tabll 2007, Goudah, Shah et al. 2008, Musa, Eisa et al. 2008, Brussow 2009, Shuiep, Kanbar et al. 2009, Bhanuprakash, Prabhu et al. 2010, Schulze zur Wiesch, Wichmann et al. 2010, Zinger-Yosovich, Iluz et al. 2010, Abu Odeh 2011, Aljumaah, Almutairi et al. 2011, Almahdy, El-Fakharany et al. 2011, Badr, Mohany et al. 2011, Monecke, Ehricht et al. 2011, Rahimi, Ameri et al. 2011, Alharbi, Al-Swailem et al. 2012, Badr 2012, Badr, Badr et al. 2012, El-Fakharany, Abedelbaky et al. 2012, Gwida, El-Gohary et al. 2012, Jans, Gerber et al. 2012, Korashy, Maayah et al. 2012, Liao, El-Fakkarany et al. 2012, Rahimi and Kheirabadi 2012, Shimol, Dukhan et al. 2012, Sprague, Al-Dahouk et al. 2012, Anvari-Tafti, Sazmand et al. 2013, Badr 2013, Bennoune, Adili et al. 2013, Cardoso, Ponte et al. 2013, Gautret, Benkouiten et al. 2013, Gautret, Benkouiten et al. 2013, Jans, Follador et al. 2013, Jans, Kaindi et al. 2013, Regassa, Golicha et al. 2013, Wang, Wang et al. 2013, Yagil 2013, Cetra 2014, Fanoy, van der Sande et al. 2014, Gebremedhin, Yunus et al. 2014, Osman, Samir et al. 2014, Redwan, El-Fakharany et al. 2014, Sahoo, Dubey et al. 2014, van Doremalen, Bushmaker et al. 2014, Al-Ashqar, Al-Mohammad Salem et al. 2015, Boughattas 2015, Kanwar, Roy et al. 2015, Koning, Kessen et al. 2015, Mohammed, Stipetic et al. 2015, Omrani, Al-Tawfiq et al. 2015, Osoro, Munyua et al. 2015, Salah, Robertson et al. 2015, Soliman, Hassan et al. 2015, Albar, El-Fakharany et al. 2016, Alqahtani, Wiley et al. 2016, Funk, Goutard et al. 2016, Garbaj, Awad et al. 2016, Garcell, Garcia et al. 2016, Gebremedhin, Dima et al. 2016, Gossner, Danielson et al. 2016, Gyuranecz, Wernery et al. 2016, Lee, Tan et al. 2016, Liu, Zhang et al. 2016, Mihic, Rainkie et al. 2016, Rhodes, Williams et al. 2016, Saeidi and Sheikhshahrokh 2016, Schuster, Sivakumar et al. 2016, Yousefi, Dehesh et al. 2016, Ali, Shehata et al. 2017.

Asthma-Related References

In addition to the above, also see the following specific references: Restani, Beretta et al. 2002, Ehlayel, Hazeima et al. 2011.

Cosmetic & Beauty

Under review. Solid, scientific references are difficult to find in this area. Nevertheless, camel's milk has also become an in-demand ingredient in creams, ointments, and masks

Full Citations and Abstracts for the Abovementioned Studies

Below is an extensive list of references in creditable scientific and medical journals relating to camel milk consumption. I am working my way through to evaluate each, and the claims they make. I have included the full abstracts of each.

Abdel-Salam, B. K. (2014). "Modulatory effect of whey proteins in some cytokines involved in wound healing in male diabetic albino rats." Inflammation **37**(5): 1616-1622.

The anti-inflammatory cytokines (interleukin (IL)-4 and IL-10) and the pro-inflammatory cytokines (IL-1beta, IL-6, and tumor necroses factor-alpha (TNF-alpha)) have important functions in wound healing. Thus, the aim of this study was to determine whether dietary supplementation with whey protein could enhance normal inflammatory responses during wound healing in diabetic rats. In this study, male albino rats were divided into a wounded control group, a wounded diabetic group, and a wounded diabetic group supplemented with whey protein orally at a dose of 100 mg/kg body weight. Tested rats showed increasing wound closure in rats treated with whey protein. In addition, after 4 days of wound, modulation in IL-4, IL-10, IL-1beta, IL-6, and TNF-alpha levels were detected. Statistical analysis of data showed significant difference between the whey-protein-treated group and either control or diabetic groups (P < 0.05). Dietary supplementation with whey protein enhances the normal inflammatory responses during wound healing in diabetic rats by modulating the levels of some anti-inflammatory and inflammatory cytokines.

Abdurahman, O. A. (1995). "Milk N-acetyl-beta-D-glucosaminidase and serum albumin as indicators of subclinical mastitis in the camel." Zentralbl Veterinarmed A **42**(10): 643-647.

NAGase activity (NAGase) and serum albumin concentrations were determined in milk from 101 traditionally managed camels in the Sudan. NAGase, a lysosomal enzyme released from damaged epithelial cells as well as other somatic cells in milk, was recorded for quarter milk samples from camels (n = 353) using the fluoroscan method. NAGase activity in major pathogen-infected quarters was significantly (P < 0.05) higher than in minor pathogen-infected and non-infected quarters. Means for minor pathogen-infected quarters were also significantly higher than non-infected quarters. Concentrations of serum albumin, resulting from increased vascular permeability, in quarter milk samples (n = 320) were measured by the radial immunodiffusion test. Serum albumin content in milk was not affected by infection status of the quarter. There were, however, large variations in serum albumin levels and, to a lesser extent, NAGase values between samples in both infected and non-infected quarters. NAGase was more effective in predicting bacteriological status of the quarter than serum albumin.

Abdurahman, O. A. (1996). "The detection of subclinical mastitis in the bactrian camel (Camelus bactrianus) by somatic cell count and California mastitis test." Vet Res Commun **20**(1): 9-14.

Milk samples (n = 160) from 7 clinically healthy bactrian camels were cultured to detect subclinical udder infection. The samples were assessed by the Californian mastitis test (CMT) and somatic cell count (SCC). Bacteria were recovered from 36 (22.5%) of the milk samples. Staphylococcus aureus and coagulase-negative staphylococci (CNS) were the main organisms found. Infected quarters had significantly higher mean values for the SCC (p < 0.01) and CMT (p < 0.001) than non-infected quarters. All 7 camels were infected with CNS but only 4 with S. aureus. CMT values for S. aureus-infected camels were significantly higher than for those only infected with CNS. The values for SCC and CMT were significantly influenced by the stage of lactation (p < 0.05). No significant difference was

found from the effect of the quarters. Both SCC and CMT were of value in predicting the infection status of the udder.

Abdurahman, O. A., et al. (1995). "Relations between udder infection and somatic cells in camel (camelus dromedarius) milk." Acta Vet Scand **36**(4): 423-431.

Quarter milk samples (n = 391) from 101 camels were examined to study the occurrence and causes of mastitis in traditionally managed camels in eastern Sudan and to evaluate the value of the California Mastitis Test (CMT), somatic cell count (SCC) and adenosine triphosphate (ATP) in the detection of subclinical mastitis in the camel. One hundred and seventy (43.5%) of the quarter milk samples yielded pathogenic bacteria. Streptococcus agalactiae, other Streptococcus spp., Staphylococcus aureus, coagulase-negative staphylococci, and Escherichia coli were isolated from milk. Thirty-two (8.2%) quarter milk samples yielded mixed cultures, and 189 (48.3%) yielded no growth. Mean values for CMT, SCC and ATP were higher for quarters infected with major pathogens. However, a significant number of quarter milk samples had elevated values in these tests but were from quarters from which no bacteria were isolated. The ability of the tests to predict a positive bacteriology increased slightly when 2 or 3 tests were combined.

Abu Odeh, R. O. (2011). "Detection and genotyping of GB virus-C in dromedary camels in the United Arab Emirates." Vet Microbiol **147**(3-4): 226-230.

GB virus-C/hepatitis G virus (GBV-C/HGV), collectively known as GBV-C, is widely spread and was discovered while searching for a causative agent for non-A-E hepatitis. The aim of this study was to determine the rate of infection and genotypic characteristics of GBV-C in Arabian camels in the United Arab Emirates (UAE). A total of 22 blood and 8 milk samples from healthy camels were screened using RT-PCR/nested PCR of the 5'-untranslated region (UTR). Phylogenetic analysis was conducted by sequencing the UTR region of randomly picked clones. The results obtained showed that the rate of GBV-C infection in camels was 18.2% (4 out of 22). All camels milk samples tested negative. Sequence analysis of the 5'-UTR using isolates from the 4 camels revealed the prevalence of the European/North American genotype 2 when compared to the 6 reference genotypes in GenBank.

Agrawal, R. P., et al. (2005). "Camel milk as an adjunct to insulin therapy improves long-term glycemic control and reduction in doses of insulin in patients with type-1 diabetes A 1 year randomized controlled trial." Diabetes Res Clin Pract **68**(2): 176-177.

Agrawal, R. P., et al. (2007). "Zero prevalence of diabetes in camel milk consuming Raica community of north-west Rajasthan, India." Diabetes Res Clin Pract **76**(2): 290-296.

OBJECTIVES: Preliminary trials reflected the low prevalence of diabetes in Raica community consuming camel milk habitually. Our objective was to describe the prevalence and clinical factors associated with impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and diabetes (DM) among adults (>or=20 years) in large population group. DESIGN: Population based, cross sectional study METHODS: 2099 participants from different villages of north-west Rajasthan were selected using stratified sampling of a representative Raica and non-Raica Community, consuming or not consuming camel milk. Demographic, clinical, anthropometric parameters were obtained and oral glucose tolerance tests were performed in all individuals to diagnose IFG, IGT and DM. Associations were investigated

using multivariate logistic regression using SPSS Version 10.0. RESULTS: In the present study, the prevalence of diabetes in Raica community consuming camel milk (RCCM, n=501) was 0%; Raica community not consuming camel milk (RCNCM, n=554) was 0.7%; non-Raica community consuming milk (NRCCM, n=515) was 0.4% and non-Raica community not consuming camel milk (NRCNCM, n=529) was 5.5%. Stepwise logistic regression analysis showed that consumption of camel milk was statistically highly significant as protective factor for diabetes. Multiple logistic regression analysis revealed that camel milk consumption and community factor were associated with decreased prevalence of diabetes. CONCLUSION: Camel milk consumption and lifestyle have definite influence on prevalence of diabetes. Hence, adopting such life pattern may play protective role in preventing diabetes to some extent.

Agrawal, R. P., et al. (2009). "Beneficial effect of camel milk in diabetic nephropathy." Acta Biomed **80**(2): 131-134.

Diabetic nephropathy is originally microvascular in nature and is widely considered an important complication of diabetes. The present study was carried out to determine the efficacy of camel milk in controlling diabetic nephropathy. Twenty-four type-1 diabetic patients were randomly recruited from the outpatient diabetic clinic in PBM Hospital, Bikaner, India. All subjects gave their written consent before participation in the study. Patients with any acute metabolic complications were not included in the study. Eligible patients entered a run-in period of 1 month in which they were oriented to achieve the best possible glycemic control through standardized diet, standardized exercise regimen and insulin administration. During this period frequent monitoring of blood sugar was performed to maintain euglycemia. At the end of the run-in period, a base line evaluation was performed, then these patients were given camel milk in addition with usual care for six months. Urine microalbumin and blood sugar was measured twice a week before breakfast and dinner. There was a significant improvement in the microalbuminuria (119.48 +/- 1.68 to 22.52 +/- 2.68; p < 0.001) after receiving camel milk for 6 months. A significant reduction in the mean dose of insulin for obtaining glycemic control was achieved (41.61 +/- 3.08 to 28.32 +/- 2.66; p < 0.01). This study was performed to observe the role of camel milk in controlling microalbuminuria levels in type-1 diabetic patients. It was observed that after adding camel milk to the usual regimen an improvement in microalbuminuria was reached (119.48 +/- 1.68 to 22.52 +/- 2.68; p < 0.001). This may be due to good glycemic control or to the direct effect of camel milk. The mechanism behind this effect is still unknown.

Agrawal, R. P., et al. (2011). "Effect of camel milk on glycemic control and insulin requirement in patients with type 1 diabetes: 2-years randomized controlled trial." Eur J Clin Nutr **65**(9): 1048-1052.

BACKGROUND/OBJECTIVES: Hypoglycemic effect of camel milk supplementation in experimental rat model and significant reduction in doses of insulin in type 1 diabetic patients have been observed in our previous studies. This long-term study was undertaken to assess the efficacy, safety and acceptability of camel milk as an adjunct to insulin therapy in type 1 diabetics. SUBJECTS/METHODS: In this 2-year randomized clinical, parallel design study, 24 type 1 diabetics were enrolled and divided into two groups. Group I (n=12) received usual care, that is, diet, exercise and insulin and Group II (n=12) received 500 ml camel milk in addition to the usual care. Insulin requirement was titrated weekly by blood glucose estimation. Results were analyzed by using the regression technique. RESULTS: In camel milk group, there was decrease in mean blood glucose (118.58+/-19-93.16+/-17.06 mg/dl), hemoglobin A1c levels (7.81+/-1.39-5.44+/-0.81%) and insulin doses (32.50+/-9.99-17.50+/-12.09 U/day, P<0.05). Out of 12 subjects receiving camel milk, insulin requirement in 3 subjects reduced to zero. There was nonsignificant change in plasma insulin and anti-insulin antibodies in both the groups. CONCLUSION: It

may be stated that camel milk is safe and efficacious in improving long-term glycemic control, with a significant reduction in the doses of insulin in type 1 diabetic patients.

Agrawal, R. P., et al. (2007). "Effect of camel milk on residual beta-cell function in recent onset type 1 diabetes." <u>Diabetes Res Clin Pract</u> **77**(3): 494-495.

Agrawal, R. P., et al. (2011). "Effect of camel milk on glucose metabolism in adults with normal glucose tolerance and type 2 diabetes in Raica community: a crossover study." <u>Acta Biomed</u> **82**(3): 181-186.

BACKGROUND: To investigate effects of camel milk consumption on insulin sensitivity and glycemic control in normal and type-2 diabetics of Raika and Non-Raika community. METHODS: 28 raika and non-raika male were enrolled in study, categorized in 2 groups, non-diabetic and diabetic after one month stabilization. Non-diabetics were supplemented with cow milk and diabetics with camel milk; followed by one-month washout period. Afterwards regimen was interchanged for 3 months. Biochemical and anthropometric data was recorded at baseline, after stabilization, before and after washout and at end of study. RESULTS: An improving trend was observed in both the groups for camel milk effect (FBS 203.86 +/- 24.09 to 161.43 +/- 11.39 mg/dl; $p<0.05$, OGTT 320.86 +/- 25.34 to 213.79 +/- 15.96 mg/dl; $p<0.05$ in diabetics and FBS 101.79 +/- 3.06 to 96.79 +/- 2.56 mg/dl, OGTT 114.36 +/- 7.99 to 100.36 +/- 6.74 mg/dl in control). HbAlc improved due to camel milk consumption (8.39 +/- 0.64 to 7.27 +/- 0.67%) whereas deteriorated in the case of cow milk (7.36 +/- 0.66 to 8.26 +/- 0.60%) in diabetic group. The HOMA-IR reduced from 13.21 +/- 4.88 to 4.38 +/- 0.75, AUC-glucose from 37253.57 +/- 2859.08 to 30724.29 +/- 3677.33 and AUC-insulin from 5871.86 +/- 1210.73 to 3301.86 +/- 629.98 in the camel milk group. CONCLUSIONS: In type-2 diabetics camel milk reduces FBS, post-prandial glucose and HbA1c. AUC-insulin and AUC-glucose also decreased significantly along with HOMA-IR. It shows hypoglycemic effect of camel milk reducing insulin resistance. (www.actabiomedica.it).

Agrawal, R. P., et al. (2013). "Camel milk: a possible boon for type 1 diabetic patients." <u>Cell Mol Biol</u> <u>(Noisy-le-grand)</u> **59**(1): 99-107.

Poor nutrition in utero and in early life combined with over nutrition in later life may also play a role in epidemic of diabetes. The efficacy of camel milk consumption as an adjunct to routine diabetic management in type 1 diabetes is a approach showing new rays of hope to cope with this disorder by adding a food supplement with medicinal values. Research on the beneficial aspects of camel milk has been taking place in different corners of globe since last three decades. Continuous efforts to disclose the role of camel milk in diabetes has rendered it title of 'white gold'. Biochemical studies has revealed the components e.g. insulin like protein, lactoferrin, immunoglobulins are responsible for imparting camel milk the scientific weightage. In parallel, epidemiological surveys stating low prevalence of diabetes in communities consuming camel milk clearly indicate towards its hopeful role in maintaining hyperglycemia. This article shades light on camel milk production, composition, characteristics as well as it expresses positive effect of camel milk on blood glucose level, insulin dose, beta cell function. This review also compiles various epidemiological studies carried out to bring forth utility of camel milk suggesting it as a useful food supplement or alternative therapy for type 1 diabetic patients.

Ahamad, S. R., et al. (2016). "Potential Health Benefits and Metabolomics of Camel Milk by GC-MS and ICP-MS." Biol Trace Elem Res.

       None of the research reports reveals the metabolomics and elemental studies on camel milk. Recent studies showed that camel milk possesses anticancer and anti-inflammatory activity. Metabolomics and elemental studies were carried out in camel milk which showed us the pathways and composition that are responsible for the key biological role of camel milk. Camel milk was dissolved in methanol and chloroform fraction and then vortexed and centrifuged. Both the fractions were derivatized by N,O-bis-(trimethylsilyl)trifluoroacetamide (BSTFA) and TMCS after nitrogen purging and analyzed by GC-MS. Camel milk was also analyzed by ICP-MS after microwave digestion. We found that higher alkanes and fatty acids are present in the chloroform fraction and amino acids, sugars and fatty acid derivatives are present in aqueous fractions. All the heavy metals like As, Pb, Cd, Co, Cu, and Ni were in the safe limits in terms of maximum daily intake of these elements. Na, K, Mg, and Ca were also present in the safe limits in terms of maximum daily intake of these elements. These results suggested that the camel milk drinking is safe and there is no health hazard. The present data of GC-MS and ICP-MS correlate the activities related to camel milk.

Ajarem, J., et al. (2015). "Neurochemical, structural and neurobehavioral evidence of neuronal protection by whey proteins in diabetic albino mice." Behav Brain Funct **11**: 7.

       BACKGROUND: Diabetes Mellitus (DM) is associated with pathological changes in the central nervous system (CNS) and alterations in oxidative stress. The aim of this study was to determine whether dietary supplement with whey protein (WP) could improve neurobehavior, oxidative stress and neuronal structure in the CNS. METHODS: Animals were distributed in three groups, a control group (N), a diabetic mellitus group (DM) and a DM group orally supplemented with WP (WP). RESULTS: The DM group of animals receiving WP had reduced blood glucose, significantly decreased free radical Diphenyl-picrylhydrazyl (DPPH) and lower lipid peroxidation in brain tissue. The WP group of animals showed improvement in balancing, coordination and fore-limb strength, oxidative stress and neuronal structure. CONCLUSION: The results of this study show that dietary supplementation with WP reduced oxidative stress, protected CNS neurons and improved the neurobehavior of diabetic mice.

Al-Ashqar, R. A., et al. (2015). "The CD markers of camel (Camelus dromedarius) milk cells during mastitis: the LPAM-1 expression is an indication of possible mucosal nature of the cellular trafficking." Res Vet Sci **99**: 77-81.

       Studying the cellular populations of the camel mammary glands through the expression pattern of the CD markers and adhesion molecules is a mean to define whether the cellular trafficking pathway is peripheral or mucosal nature. Camel milk cells from 8 Gram-positive and 5 Gram-negative infected camels were examined with flow cytometry using cross-reacting antibodies like, anti-CD4(+), CD8(+), WC+1(+)gammadelta, CD62L, CD11a(+)/CD18, LPAM-1, CXCR2. The overall results indicated high flow cytometry output of most of the CD makers. The statistical analysis of the mean percentage of the expressed CD markers has shown that CD62L, CXCR-2, LPAM-1, CD11a/CD18, CD8(+), IL-6R and CD20(+) were expressed in significant differences in either type of the infection. The LPAM-1 expression has provided further support to the notion that the lymphocyte trafficking is of the mucosal nature. The mucosal origin of cellular trafficking has important implications on the vaccine design and therapeutical approaches to mastitis.

Al-Hammadi, S., et al. (2010). "Anaphylaxis to camel milk in an atopic child." Allergy **65**(12): 1623-1625.

Al-Moslih, M. I., et al. (2007). "Genetic relationship of Torque Teno virus (TTV) between humans and camels in United Arab Emirates (UAE)." J Med Virol **79**(2): 188-191.

Torque Teno Virus (TTV) species-cross infection has been documented. However, the genetic relationship between human and animal TTV remains uncertain. In this study, genotypic characterization of TTV in different Camel specimens from the United Arab Emirates (UAE) was undertaken for comparison with human UAE TTV. A total of 56 specimens: 34 sera, 14 raw, and 8 pasteurized milk samples were tested for TTV. The results showed that the rate of infection was, 38.2% (13/34), 35.7% (5/14), and 100% (8/8), for the samples of sera, raw, and pasteurized milk respectively. The 5'untranslated region (5'UTR) of 23 clones that were generated from PCR products amplified from Camel samples (three sera, three raw, and two pasteurized milk samples) were subjected to sequence analysis. The camel TTV clones were classified as genotype 11 (47.8%), group 5 (43.5%), and SENV-H or genotype 16 (8.7%) which are among the predominant genotypes found in humans in the UAE. Phylogenetic analysis of representative sequences revealed that the similarity between isolates from camels and humans is 92%-97% for the same genotypes. The data lead to the conclusion that camels and humans share a common source of TTV infection in the UAE.

Albar, A. H., et al. (2016). "In vitro exploration of the anti-HCV potential of the synthetic spacer peptides derived from human, bovine, and camel lactoferrins." Protein Pept Lett.

Chronic liver disease is often associated with the infection by hepatitis C virus (HCV), which is an enveloped RNA virus belonging to the Flaviviridae family. Many studies found that milk proteins, such as lactoferrin, might have profound antiviral activity against HCV. Various secretory fluids ranging from milk, to tears, saliva, and nasal secretion, and to bile and pancreatic juice, as well as neutrophils, mucosal surfaces, and blood contain a widely spread multifunctional glycoprotein, lactoferrin (Lf), structure of which can be depicted as two homologous domains connected by the short spacer peptide. This study aimed to understand the effectiveness of the synthetic peptides cLfsp, bLfsp, hLfsp1, and hLfsp2 corresponding to the spacer peptides of camel, bovine, and human Lfs, respectively, against HCV in in vitro settings. To this end, we used RT-nested PCR to evaluate the antiviral activity of the synthesized spacer peptides against HCV infectivity in PBMC and HepG2 cells looking at their neutralization, protection, and intracellular treatment potentials. We show that direct interaction of hLfsp1, hLfsp2, and bLfsp with viral particles is able to neutralize the HCV entry into HepG2 cells (with hLfsp2 being more potent neutralizer than hLfsp1 and bLfsp), whereas cLfsp does not show any neutralizing potential. Therefore, our analysis revealed that different spacer peptides are characterized by different antiviral potentials and use different mechanisms for antiviral protection.

Alhaider, A. A., et al. (2014). "Camel milk inhibits inflammatory angiogenesis via downregulation of proangiogenic and proinflammatory cytokines in mice." APMIS **122**(7): 599-607.

Camel milk has traditionally been used to treat cancer, but this practice awaits scientific scrutiny, in particular its role in tumor angiogenesis, the key step involved in tumor growth and metastasis. We aimed to investigate the effects of camel milk on key components of inflammatory angiogenesis in sponge implant angiogenesis model. Polyester-polyurethane sponges, used as a framework for fibrovascular tissue growth, were implanted in Swiss albino mice and camel milk (25, 50 and 100 mg/kg/day) was administered for 14 days through installed cannula. The implants collected at

day 14 post-implantation were processed for the assessment of hemoglobin (Hb), myeloperoxidase (MPO), N-acetylglucosaminidase (NAG), and collagen, which were used as indices for angiogenesis, neutrophil, and macrophage accumulation and extracellular matrix deposition, respectively. Relevant inflammatory, angiogenic, and fibrogenic cytokines were also determined. Camel milk treatment attenuated the main components of the fibrovascular tissue, wet weight, vascularization (Hb content), macrophage recruitment (NAG activity), collagen deposition and the levels of vascular endothelial growth factor (VEGF), interleukin (IL)-1beta, IL-6, IL-17, tumor necrosis factor-alpha, and transforming growth factor-beta. A regulatory function of camel milk on multiple parameters of the main components of inflammatory angiogenesis has been revealed, giving insight into the potential therapeutic benefit underlying the anti-cancer actions of camel milk.

Alharbi, K. B., et al. (2012). "Pathology and molecular diagnosis of paratuberculosis of camels." Trop Anim Health Prod **44**(1): 173-177.

Camels are the prime source of meat and milk in many desert regions of the world including Saudi Arabia. Paratuberculosis of camels, locally called Silag, is a serious and invariably fatal disease in the Arabian camel. Six camels were used in this study. Five camels with clinical paratuberculosis were used to study the pathology of the disease and confirm its aetiology. The sixth camel was clinically healthy and used as a control. The camels were examined clinically and bled for haematological and blood chemistry analysis. They were then humanely killed with a high intravenous dose of thiopental sodium (10 mg/kg) for pathological studies as well as obtaining tissues for microbiological and molecular studies. The clinical signs of the disease were emaciation, diarrhoea, alopecia, wry neck and pale mucous membranes. Laboratory diagnosis showed reduced haemoglobin concentration, low haematocrit and high activity of the serum enzyme alanine aminotransferase. Serum creatinine concentration was normal. These results indicated the infected camels were anaemic and the function of their livers was affected. Postmortem examination showed thickened and corrugated intestinal mucosa, enlarged granulomatous mesenteric lymph nodes, miliary and diffuse granulomas in the liver (in four camels), generalized lymph node granulomas (in one camel), splenic granuloma (in one camel) and mediastinal lymph node granuloma (in two camels). Histopathological examination showed diffuse infiltration of macrophages in all organs showing lesions. Ziehl-Neelsen staining of tissue scraping and tissue sections showed masses of acid fast bacilli, except for the spleen. Infection with Mycobacterium avium subsp. paratuberculosis was confirmed by PCR by targeting the IS900 gene.

Ali, M. A., et al. (2017). "Systematic, active surveillance for Middle East respiratory syndrome coronavirus in camels in Egypt." Emerg Microbes Infect **6**(1): e1.

Middle East respiratory syndrome coronavirus (MERS-CoV) causes severe human infections and dromedary camels are considered an intermediary host. The dynamics of natural infection in camels are not well understood. Through systematic surveillance in Egypt, nasal, rectal, milk, urine and serum samples were collected from camels between June 2014 and February 2016. Locations included quarantines, markets, abattoirs, free-roaming herds and farmed breeding herds. The overall seroprevalence was 71% and RNA detection rate was 15%. Imported camels had higher seroprevalence (90% vs 61%) and higher RT-PCR detection rates (21% vs 12%) than locally raised camels. Juveniles had lower seroprevalence than adults (37% vs 82%) but similar RT-PCR detection rates (16% vs 15%). An outbreak in a breeding herd, showed that antibodies rapidly wane, that camels become re-infected, and that outbreaks in a herd are sustained for an extended time. Maternal antibodies titers were very low in calves regardless of the antibody titers of the mothers. Our results support the hypothesis that camels

are a reservoir for MERS-CoV and that camel trade is an important route of introducing the virus into importing countries. Findings related to waning antibodies and re-infection have implications for camel vaccine development, disease management and zoonotic threat.

Aljumaah, R. S., et al. (2011). "Factors influencing the prevalence of subclinical mastitis in lactating dromedary camels in Riyadh Region, Saudi Arabia." Trop Anim Health Prod **43**(8): 1605-1610.

The purpose of this study was to determine the prevalence of subclinical mastitis in camels in Riyadh, Saudi Arabia and the factors influencing its incidence. A total of 740 quarter milk samples were collected from 47 camel herds belonging to Majahim, Maghatir, Shu'l, and Sufer breeds. California mastitis test (CMT) was used as a screening test for subclinical mastitis. Samples giving negative or trace CMT scores (0) were assigned to healthy quarters, while those giving positive scores of 1+ to 3+ were assigned to subclinically affected quarters. Logistic regression was used to assess the association of breed, parity, and stage of lactation with the prevalence of subclinical mastitis. Milk fat, protein, lactose, solid nonfat percentages and Na, Ca, and K concentrations were compared in CMT-positive versus healthy quarters. One third (33%) of tested quarters had subclinical mastitis based on CMT. The estimated probability of subclinical mastitis with the combined effects of breed, parity, and stage of lactation ranged from 15.8% to 54.6%. The risk of subclinical mastitis increased significantly with parity and with the early stage of lactation. The Shu'l breed had significantly higher prevalence of subclinical mastitis than other breeds. Significant decreases in protein, lactose, and solid nonfat, Ca and K concentrations and increase in Na concentrations were associated with subclinical mastitis. In conclusion, subclinical mastitis is prevalent in Saudi camels, and its incidence is influenced by breed, parity, and stage of lactation.

Almahdy, O., et al. (2011). "Examination of the activity of camel milk casein against hepatitis C virus (genotype-4a) and its apoptotic potential in hepatoma and hela cell lines." Hepat Mon **11**(9): 724-730.

BACKGROUND: Hepatitis C is a global health concern that represents a major cause of liver disease and socioeconomic burden. Currently, there is no vaccine that protects against this infection or drug that treats it effectively. The current treatment for hepatitis C virus (HCV) infection does not produce a sustained virologic response. Therefore,discovery and identification of a new drug for HCV treatment is a high priority.Camel milk is a traditional medicine that could improve the control of HCV. OBJECTIVES: To assess the potential effect of casein purified from camel milk on HCV cellular infectivity in a tissue culture model. MATERIALS AND METHODS: Casein was purified from defatted camel milk to electrophoretic homogeneity. PBMCs and HepG2 and HeLa cell lines were used. Three kinds of experiments were conducted. HCV was directly interacted with casein and then mixed with different cell types, casein was incubated with the cells and then exposed to HCV, and the HCV pre-infected cells were treated with casein at different concentrations and time intervals. Non-infected cells were used to assess cytotoxicity and the apoptosis effect of casein. RESULTS: Direct interaction of casein (with or without alpha-lactalbumin) with neither the virus nor the cells prevented HCV cell entry. However, casein with alpha-lactalbumin induced a cytotoxic effect in HepG2 and HeLa cell lines but not in human naive leukocytes. At all concentrations tested, casein with alpha-lactalbumin could induce apoptosis in both infected and non-infected HepG2 cells. CONCLUSIONS: Camel milk casein (with or without alpha-lactalbumin) did not demonstrate any anti-HCV activity. However, the cellular apoptotic cascade was initiated in HepG2 and HeLa cells treated with casein (with alpha-lactalbumin) but not in naive leukocytes.

Almer, L. O. (1985). "A case of brucellosis complicated by endocarditis and disseminated intravascular coagulation." Acta Med Scand **217**(1): 139-140.

Brucellosis, being eradicated among domestic animals in some countries, is still prevalent in some others where it poses a potential threat to the consumers of milk and cheese and those working with animals and meat. The patient presented below had contracted a severe and long-standing Brucella abortus infection by ingesting raw camel milk. She had signs of endocarditis and disseminated intravascular coagulation, but recovered when treated with tetracyclin and streptomycin.

Alqahtani, A. S., et al. (2016). "Camel exposure and knowledge about MERS-CoV among Australian Hajj pilgrims in 2014." Virol Sin **31**(1): 89-93.

Angrisani, V. (1962). "[Considerations on the relation between feeding with cow's milk and camel milk, in Somaliland, and possible tuberculosis infection]." Arch Ital Sci Med Trop Parassitol **43**: 205-210.

Anvari-Tafti, M., et al. (2013). "Gastrointestinal helminths of camels (Camelus dromedarius) in center of Iran." Trop Biomed **30**(1): 56-61.

Camels are multipurpose animals in Iran. As parasitic diseases are the major cause of impaired meat and milk production in this animal, the present study aimed at determining gastrointestinal helminthic infections of Iranian camels in the center of the country. Gastrointestinal (GI) tract of 144 carcasses of one-humped camels (Camelus dromedarius) slaughtered in Yazd, Esfahan and Kerman provinces' abattoirs were examined for adult helminths. Camels were from both sexes and different ages. Recovered parasites were identified according to described keys by light microscope. Of 144 tested camels, 117 were infected with at least one helminth species (81.3%). A total of 28 worm species from 14 genera were identified in the digestive tract of infected animals, including 26 species of nematodes and two species of cestodes. The infection rates in stomach, small intestine, and caecum/large intestine were 86.3%, 91.5% and 11.1%, respectively. However, no worm was found in the oesophagus. The recovered worms with infection rates are discussed in this paper. In the present study, Haemonchus tataricus, Trichostrongylus hamatus and Trichuris infundibulus are reported from Iranian dromedaries for the first time. Regarding high prevalence of infection, using anthelminthic drugs seemed necessary to improve the health and productivity of camels. On the other hand, the high rate of zoonotic species indicated that camels have important role in maintaining and transmitting infection to humans.

Arab, H. H., et al. (2014). "Camel's milk ameliorates TNBS-induced colitis in rats via downregulation of inflammatory cytokines and oxidative stress." Food Chem Toxicol **69**: 294-302.

Current treatment strategies for inflammatory bowel diseases (IBD) are associated with several adverse effects, and thus, the search for effective agents with minimal side effects merits attention. Camel's milk (CM) is endowed with antioxidant/anti-inflammatory features and has been reported to protect against diabetes and hepatic injury, however, its effects on IBD have not been previously explored. In the current study, we aimed to investigate the potential alleviating effects of CM against TNBS-induced colitis in rats. CM (10 ml/kg b.i.d. by oral gavage) effectively suppressed the severity of colon injury as evidenced by amelioration of macroscopic damage, colon weight/length ratio, histopathological alterations, leukocyte influx and myeloperoxidase activity. Administration of CM

mitigated the colonic levels of TNF-alpha and IL-10 cytokines. The attenuation of CM to colon injury was also associated with suppression of oxidative stress via reduction of lipid peroxides and nitric oxide along with boosting the antioxidant defenses through restoration of colon glutathione and total anti-oxidant capacity. In addition, caspases-3 activity, an apoptotic marker, was inhibited. Together, our study highlights evidences for the promising alleviating effects of CM in colitis. Thus, CM may be an interesting complementary approach for the management of IBD.

Badr, G. (2012). "Supplementation with undenatured whey protein during diabetes mellitus improves the healing and closure of diabetic wounds through the rescue of functional long-lived wound macrophages." Cell Physiol Biochem 29(3-4): 571-582.

Long and persistent uncontrolled diabetes tends to degenerate the immune system and increase the incidence of infections in diabetic patients. A serious complication of diabetes is impaired healing, which diminishes physical activity and, in some cases, leads to chronic wounds and limb amputation. Whey proteins (WPs) enhance immunity during early development and have a protective role in some immune disorders. The effect of camel WPs on wound healing in a streptozotocin-induced type 1 diabetic mice model was investigated. Sixty male mice were equally distributed into 3 experimental groups: group 1, non-diabetic control mice; group 2, diabetic mice; and group 3, diabetic mice that were orally supplemented with undenatured WP (100 mg/kg body weight/day for 1 month through oral gavage). We observed that the diabetic mice exhibited delayed wound closure characterized by a significant reduction in collagen deposition, prolonged elevation in inflammatory cytokines, aberrant activation of STAT3 and reduction in the activation of Akt and NF-kappaB when compared with the control mice. Moreover, in the diabetic mice, the wound-resident macrophages were dysfunctional and demonstrated increased apoptosis, a significant reduction in their phagocytotic ability, aberrant activation of STAT3 and a marked reduction in the activation of Akt. Interestingly, the supplementation of diabetic mice with WP significantly enhanced the collagen deposition, limited the inflammatory stimuli, restored the activation of STAT3, Akt and NF-kappaB and greatly improved the closure of diabetic wounds compared with the control mice. Most important, the supplementation of diabetic mice with WP rescued functional, long-lived wound-resident macrophages. Our data reveal the benefits of WP supplementation in improving the healing and closure of diabetic wounds.

Badr, G. (2013). "Camel whey protein enhances diabetic wound healing in a streptozotocin-induced diabetic mouse model: the critical role of beta-Defensin-1, -2 and -3." Lipids Health Dis 12: 46.

BACKGROUND: Delayed wound healing is considered one of the most serious diabetes-associated complications. The presence of replicating organisms such as bacteria within a diabetic's wound is considered one of the most important factors that impair cutaneous wound healing and the potential cellular and/or molecular mechanisms that are involved in the healing process. Defensins, which are anti-microbial peptides, have potent bactericidal activity against a wide spectrum of the bacterial and fungal organisms that are commonly responsible for wound infections. We recently demonstrated that camel whey proteins (WPs) expedite the healing of diabetic wounds by enhancing the immune response of wounded tissue cells and by alleviating some of the diabetic complications. METHODS: In the present study, we investigated the effects of WP supplementation on the mRNA and protein expression levels of beta-defensin-1 (BD-1), 2 and 3 and subsequently on the wound healing process in a streptozotocin (STZ)-induced diabetic mouse model. In this study, three groups of mice were used (10 mice per group): group 1, the non-diabetic mice (control); group 2, the diabetic mice; and group 3, the diabetic mice that received a daily supplement of undenatured WP (100 mg/kg of body

weight) via oral gavage for 1 month. RESULTS: Compared with the non-diabetic control mice, the diabetic mice exhibited delayed wound closure that was characterized by a reduction in hydroxyproline content (indicator of collagen deposition), a marked elevation in free radical levels and a prolonged elevation in the levels of inflammatory cytokines, including interleukin-6 (IL-6), transforming growth factor-beta (TGF-beta) and tumor necrosis factor-alpha (TNF-alpha). Interestingly, compared with the diabetic mice that did not receive WP supplementation, the diabetic mice with WP had an accelerated closure and healing process of their wounds. The WP supplementation also decreased their levels of free radicals and restored their hydroxyproline content; proinflammatory cytokine levels; and expression of BD-1, 2 and 3 in the wounded tissue. CONCLUSION: WP supplementation may be beneficial for improving the healing and closure of diabetic wounds.

Badr, G., et al. (2012). "Treatment of diabetic mice with undenatured whey protein accelerates the wound healing process by enhancing the expression of MIP-1alpha, MIP-2, KC, CX3CL1 and TGF-beta in wounded tissue." BMC Immunol **13**: 32.

BACKGROUND: Continuous diabetes-associated complications are a major source of immune system exhaustion and an increased incidence of infection. Diabetes can cause poor circulation in the feet, increasing the likelihood of ulcers forming when the skin is damaged and slowing the healing of the ulcers. Whey proteins (WPs) enhance immunity during childhood and have a protective effect on some immune disorders. Therefore, in this study, we investigated the effects of camel WP on the healing and closure of diabetic wounds in a streptozotocin (STZ)-induced type I diabetic mouse model. RESULTS: Diabetic mice exhibited delayed wound closure characterized by a significant decrease in an anti-inflammatory cytokine (namely, IL-10) and a prolonged elevation of the levels of inflammatory cytokines (TNF-alpha, IL-1beta and IL-6) in wound tissue. Moreover, aberrant expression of chemokines that regulate wound healing (MIP-1alpha, MIP-2, KC and CX3CL1) and growth factors (TGF-beta) were observed in the wound tissue of diabetic mice compared with control nondiabetic mice. Interestingly, compared with untreated diabetic mice, supplementation with WP significantly accelerated the closure of diabetic wounds by limiting inflammatory stimuli via the restoration of normal IL-10, TNF-alpha, IL-1beta and IL-6 levels. Most importantly, the supplementation of diabetic mice with WP significantly modulated the expression of MIP-1alpha, MIP-2, KC, CX3CL1 and TGF-beta in wound tissue compared with untreated diabetic mice. CONCLUSION: Our data demonstrate the benefits of WP supplementation for improving the healing and closure of diabetic wounds and restoring the immune response in diabetic mice.

Badr, G., et al. (2011). "Effects of undenatured whey protein supplementation on CXCL12- and CCL21-mediated B and T cell chemotaxis in diabetic mice." Lipids Health Dis **10**: 203.

BACKGROUND: Long and persistent uncontrolled diabetes tends to degenerate the immune system and leads to an increased incidence of infection. Whey proteins (WPs) enhance immunity during early life and have a protective role in some immune disorders. In this study, the effects of camel WP on the chemotaxis of B and T cells to CXCL12 and CCL21 in diabetic mice were investigated. RESULTS: Flow cytometric analysis of the surface expressions of CXCR4 (CXCL12 receptor) and CCR7 (CCL21 receptor) on B and T cells revealed that the surface expressions of CXCR4 and CCR7 were not significantly altered in diabetic and WP-supplemented diabetic mice compared with control mice. Nevertheless, B and T lymphocytes from diabetic mice were found to be in a stunned state, with a marked and significant ($P < 0.05$) decrease in CXCL12- and CCL21-mediated actin polymerization and subsequently, a marked decrease in their chemotaxis. WP supplementation in the diabetes model was found to significantly

increase CXCL12- and CCL21-mediated actin polymerization and chemotaxis in both B and T cells. CONCLUSION: Our data revealed the benefits of WP supplementation in enhancing cytoskeletal rearrangement and chemotaxis in B and T cells, and subsequently improving the immune response in diabetic mice.

Barbour, E. K., et al. (1985). "Mastitis in Camelus dromedarius in Saudi Arabia." Trop Anim Health Prod **17**(3): 173-179.

The correlation between camels' milk samples collected from abnormal inflamed udders and samples positive in the California Mastitis Test (CMT) was +0.803 (P less than 0.01). The bacterial count ranges of milk samples differed significantly (P less than 0.05) for those with a negative CMT and those with a positive CMT. Infection with many but not all bacterial species was associated with positive CMT results. The highest percentage of camel milk samples was included in the bacterial count range of 3.0 x 10(2) to 3.0 x 10(3) cfu/ml rather than in the greater than 3.0 x 10(3) cfu/ml range for most of the bacterial species. The most predominant bacterial isolates were Micrococcus spp., Staphylococcus aureus, Streptococcus spp. and Corynebacterium spp. followed by eight other flora. Chloramphenicol was the most effective antimicrobial agent of six tested against 118 bacterial isolates. Preliminary observations are made on chemotherapy of mastitis cases in camels.

Bekele, T. and B. Molla (2001). "Mastitis in lactating camels (Camelus dromedarius) in Afar Region, north-eastern Ethiopia." Berl Munch Tierarztl Wochenschr **114**(5-6): 169-172.

Quarter milk samples (n = 543) from 152 traditionally managed lactating camels (Camelus dromedarius) in Afar Region, north-eastern Ethiopia were examined to determine the prevalence of camel mastitis and identify its bacterial causes. Out of 152 camels examined, 19 (12.5%) were diagnosed as clinical mastitis cases based on clinical signs and bacteriological examinations. Of the 257 California Mastitis Test (CMT) positive quarter milk samples 162 (63.0%) yielded pathogenic bacteria. A positive correlation was observed between CMT positive results and presence of major pathogens in camel milk samples. The main mastitis pathogens isolated were Staphylococcus aureus, coagulase-negative staphylococci, Streptococcus agalactiae, S. dysgalactiae, and other species of streptococci, Pasteurella haemolytica and E. coli. Results of the present study suggest that mastitis in Afar camels is prevalent, Gram-positive cocci are the major isolates from camel milk samples and the CMT can be used as a screening test for the detection of mastitis in camels.

Ben-Arye, E., et al. (2016). "Potential risks associated with traditional herbal medicine use in cancer care: A study of Middle Eastern oncology health care professionals." Cancer **122**(4): 598-610.

BACKGROUND: The authors assessed the use of herbal medicine by Middle Eastern patients with cancer, as reported by their oncology health care professionals (HCPs). Herbal products identified by the study HCPs were evaluated for potential negative effects. METHODS: Oncology HCPs from 16 Middle Eastern countries received a 17-item questionnaire asking them to list 5 herbal products in use by their patients with cancer. A literature search (PubMed, Micromedex, AltMedDex, and the Natural Medicine Comprehensive Database) was conducted to identify safety-related concerns associated with the products listed. RESULTS: A total of 339 HCPs completed the study questionnaire (response rate of 80.3%), identifying 44 herbal and 3 nonherbal nutritional supplements. Safety-related concerns were associated with 29 products, including herb-drug interactions with altered pharmacodynamics (15 herbs), direct toxic effects (18 herbs), and increased in vitro response of cancer cells to chemotherapy (7

herbs). CONCLUSIONS: Herbal medicine use, which is prevalent in Middle Eastern countries, has several potentially negative effects that include direct toxic effects, negative interactions with anticancer drugs, and increased chemosensitivity of cancer cells, requiring a reduction in dose-density. Oncology HCPs working in countries in which herbal medicine use is prevalent need to better understand the implications of this practice. The presence of integrative physicians with training in complementary and traditional medicine can help patients and their HCPs reach an informed decision regarding the safety and effective use of these products.

Bennoune, O., et al. (2013). "Trypanosomiasis of camels (Camelus dromedarius) in Algeria: First report." Vet Res Forum **4**(4): 273-275.

Camel trypanosomosis is a life-threatening disease in the camel species and responsible for severe economic losses either in milk or meat productions. This study was carried out on the south-east area of Algeria on 100 camels of various ages and either sex from two herds. Microscopic examination of blood smears revealed higher levels of trypanosomosis caused by Trypanosoma evansi, an elongated parasite with a kinetoplast and a single nucleus located in its half-length and one flagellum with great heterogeneity. This first investigation reveals higher infection rate than those observed in other countries using blood smears, the trypanosomosis attack has reached an alarming level and the occurrence of trypanosomosis at this high level on blood smears is like "the tree that hides the forest" and make up a serious and potential danger both on animal and public health. Therefore, radical preventive and offensive drastic measures must be taken against this menacing disease at the critical points to prevent the economic losses and to avoid possible human transmission.

Bhanuprakash, V., et al. (2010). "Camelpox: epidemiology, diagnosis and control measures." Expert Rev Anti Infect Ther **8**(10): 1187-1201.

Camelpox is an economically important contagious skin disease of camelids caused by camelpox virus (CMLV) and is characterized by mild local skin infection and less common severe systemic infections. The disease is confined to camel-rearing belts particularly in developing countries and causes economic impact due to considerable loss in terms of morbidity, mortality, loss of weight and reduction in milk yield. The virus has gained attention from researchers due to its recent emergence with close genetic relatedness to variola virus, the causative agent of smallpox, and carrying genes responsible for host immune evasion mechanisms. CMLV was earlier thought to be a zoonotic agent but so far little evidence has been documented from Somalia. Although the disease can be diagnosed based on clinical signs, the similar confounding skin lesions necessitate identification of infection by molecular biology based diagnostic techniques, namely restriction enzyme analysis of the virus genome and specific genes, genus- and species-specific diagnostic PCRs including real-time quantitative PCR, and sequence and phylogenetic analysis for diagnosis and differentiation of CMLV. The entire genome sequence of CMLV is known and it contains more than 211 putative genes, which code for different proteins with host range, immunomodulation, virulence and other functions. Both inactivated and live-attenuated vaccines are available in some countries. However, live vaccines are preferred as they provide long-lasting immunity. Considering the virus spreads through contaminated environments, an improved diagnostic and control method would be of immense value to curtail the infection in the field. Alternative therapeutics such as antiviral agents is an area that needs to be explored. This article discusses the epidemiology and biology of the disease, novel diagnostic approaches and control measures.

Bhat, D. K., et al. (2014). "The Raikas - a unique combination of high prevalence of type 1 diabetes susceptibility genes and near zero incidence of the disease." Hum Immunol **75**(12): 1252-1258.

The Raikas, a camel rearing tribal group living in the Thar desert of Rajasthan has been reported with a very low incidence of diabetes. We analysed the frequency distribution of HLA alleles in this community and compared the same with the non-Raika group living in the same geographic location and also that of the healthy North Indian (NI) population. The data revealed an exceptionally high phenotype frequency of HLA-DRB1*03 in this community (53%) as compared to the non-Raika group (27.73%, p=7.9E-05) and the NI population (14.6%, p=7.65E06). Further analysis revealed the occurrence of four major DRB1*03 haplotypes in the Raikas: (i) A*26-B*08-DRB1*03 (AH8.2, 11.76%); (ii) A*24-B*08-DRB1*03 (AH8.3, 8.82%); (iii) A*02-B*08-DRB1*03 (3.78%); (iv) A*01-B*08-DRB1*03 (AH8.1v, 0.84%); all of which occurred with a several fold higher frequency in the Raikas than the other two groups. These haplotypes have been reported to be positively associated with T1D in the NI population. The apparent lack of T1D and/or other autoimmune diseases in the Raikas despite the higher occurrence of known disease associated HLA alleles/haplotypes is intriguing and highlights the quintessential role of the environmental factors, food habits and level of physical activity in the manifestation of T1D. Possible influence of other protection conferring genes located on, as yet undefined chromosomal locations cannot be ruled out.

Boughattas, S. (2015). "Commentary on: "Detection of Toxoplasma gondii in raw caprine, ovine, buffalo, bovine, and camel milk using cell cultivation, cat bioassay, capture ELISA, and PCR methods in Iran"." Front Microbiol **6**: 215.

Brussow, H. (2009). "Europe, the bull and the Minotaur: the biological legacy of a Neolithic love story." Environ Microbiol **11**(11): 2778-2788.

The European cattle was domesticated 10 000 years ago in eastern Turkey, 1000 years later pottery-associated milk fats identify cattle-based dairy activity in western Turkey. Subsequently, the Indo-European language, domesticated animals and plants travel as a Neolithic package along two major routes across Europe. A striking south-east to north-west gradient of a mutation in the current European population (lactase persistence into adulthood) documents the expansion of a Neolithic dairy culture into a Mesolithic hunter society. Using oral tradition (myths), archaeological and written historical evidence and biological data, it is asked whether highly transmissible viral diseases like measles and smallpox entered during the Neolithic from domesticated animals into the human population. The bovine origin of paramyxovirus infections is likely; smallpox comes from camels or from rodents via cattle while mycobacteria and Helicobacter infected humans already before the Neolithic. Microbes adapt constantly and quickly to changing ecological situations. The current global environmental changes will lead to another highly dynamic phase of viral transmissions into the human population.

Cardoso, R. R., et al. (2013). "Protective action of camel milk in mice inoculated with Salmonella enterica." Isr Med Assoc J **15**(1): 5-8.

BACKGROUND: In some countries people believe that camel milk can protect against various aggressors, whether due to infections, diabetes, or even autism. Little has been scientifically demonstrated regarding the veracity of these beliefs. OBJECTIVES: To study the anti-infectious action of camel milk. METHODS: Fifty mice were divided into 5 groups of 10 animals each: 3 control groups and 2 test groups. Except for one of the control groups, all groups were intraperitoneally inoculated with a

strain of Salmonella enterica. The rations in the test groups were supplemented with camel milk or cow milk. RESULTS: A statistically significant survival was observed in the mice supplemented with camel milk. The death rate after Salmonella inoculation was only 40% in the study group, as compared to 100% in the control groups where the mice were not protected, and 80% in the group supplemented with cow milk and injected with Salmonella. CONCLUSIONS: Camel milk is an excellent nutrient and because of its specific properties, particularly its anti-infectious action, should be used to replace other milks.

Cetra, A. (2014). "MERS-CoV update: what you need to know." Lancet Infect Dis **14**(10): 924-925.

Ebaid, H. (2014). "Promotion of immune and glycaemic functions in streptozotocin-induced diabetic rats treated with un-denatured camel milk whey proteins." Nutr Metab (Lond) **11**: 31.

   T cell mediated autoimmune diabetes is characterized by immune cell infiltration of pancreatic islets and destruction of insulin-producing beta-cells. This study was designed to assess the effect of whey proteins (WP) on the responsiveness of lymphocytes in rats after four months of Streptozotocin (STZ)-induced Type 1 diabetes (T1D). A diabetic group was supplemented with WP daily for five weeks at a dose of 100 mg/kg. Ribonucleic acid (RNA) was extracted from stimulated lymphocytes in order to analyse gene expressions using real time PCR and RT-PCR. PCR results were confirmed with ELISA. The proliferation capacity of lymphocytes and their homing to the spleen were studied. Antigen-activated lymphocytes showed that diabetes impaired the mRNA expression of the protein kinase B (Akt1), Cdc42, and the co-stimulatory molecule, CD28, which are important for cell survival, actin polymerization and T cell activation, respectively. Accordingly, proliferation of lymphocytes was found to be suppressed in diabetic rats, both in vivo and in vitro. WP was found to restore Akt1, Cdc42 and CD28 mRNA expression during diabetes to normal levels. WP, therefore, served to activate the proliferation of B lymphocytes in diabetic rats both in vivo and in vitro. Although WP was found to up-regulate mRNA expression of both interleukin (IL)-2 and interferon gamma (IFN-gamma), it suppressed the proliferation activity of almost all T cell subsets. This was confirmed by WP normalizing the structure and function of ss cells. Meanwhile, WP was found to down regulate the mRNA expression of Tumor necrosis factor-alpha (TNF-alpha) and its programmed cell death-receptor (Fas). Taken together, the results of this study provide evidence for the potential impact of WP in the treatment of immune impairment in T1D, suggesting that it serves to reverse autoimmunity by suppressing autoreactive T cells and down regulating TNF-alpha and Fas, resulting in improved pancreatic ss cell structure and function.

Ebaid, H., et al. (2015). "Camel milk peptide improves wound healing in diabetic rats by orchestrating the redox status and immune response." Lipids Health Dis **14**: 132.

   BACKGROUND: Diabetes mellitus alters oxidative stability and immune response. Here, we investigated the impact of a peptide extracted from camel milk (CMP) on the oxidative status, transcription factor kappa-B (NF-kB) and inflammatory cytokine in diabetic wounds. METHODS: Rats were assigned into three groups: control, diabetic induced (DM) and diabetic induced with multiple doses of CMP for a week (DM-CMP). RESULTS: DM showed a sharp decline in the activity of major antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH) compared to the control. The DM-CMP group, however, showed a noticeable replenishment in the activity of these enzymes compared to the DM group. The CMP-treated group also showed a normal level of lipid peroxidation marker (MDA) compared to the DM rats. Furthermore, ELISA analysis of serum TNF-alpha protein showed an elevated level in diabetic rats in comparison to control serum. However,

RT-PCR analysis of locally wounded skin tissues revealed that diabetes down-regulates the RNA expression of both TNF-alpha and MIF genes in comparison to the control samples but that CMP was found to restore RNA expression significantly. Although it was elevated in CMP-treated rats after one day of wound incision, the NF-kB protein level was significantly decreased seven days after the incision in comparison to the animals in the diabetic group. CONCLUSION: CMP, therefore, can be seen an effective antioxidant and immune stimulant that induces oxidative stability and speeds up wound healing in diabetic model animals, making it a potential adjuvant in improving wound healing in those with diabetic conditions.

Ebaid, H., et al. (2013). "Limiting prolonged inflammation during proliferation and remodeling phases of wound healing in streptozotocin-induced diabetic rats supplemented with camel undenatured whey protein." BMC Immunol **14**: 31.

BACKGROUND: Impaired diabetic wound healing occurs as a consequence of excessive reactive oxygen species (ROS) and inflammatory cytokine production. We previously found that whey protein (WP) was able to normally regulate the ROS and inflammatory cytokines during the inflammatory phase (first day) in streptozotocin (STZ)-diabetic wound healing. This study was designed to assess the effect of WP on metabolic status, the inflammation and anti-inflammation response, oxidative stress and the antioxidant defense system during different phases of the wound healing process in diabetic rats. WP at a dosage of 100 mg/kg of body weight, dissolved in 1% CMC, was orally administered daily to wounded normal (non-diabetic) and STZ-induced diabetic rats for 8 days starting from the 1st day after wounding. RESULTS: The data revealed that WP enhanced wound closure and was associated with an increase in serum insulin levels in diabetic rats and an alleviation of hyperglycemic and hyperlipidemic states in diabetic animals. The increase in insulin levels as a result of WP administration is associated with a marked multiplication of beta-cells in the core of islets of Langerhans. WP induced a reduction in serum TNF-alpha, IL-1beta and IL-6 levels and an increase in IL-10 levels, especially on the 4th day after wounding and treatment. WP also suppressed hepatic lipid peroxidation and stimulated the antioxidant defense system by increasing the level of glutathione and the activity of glutathione-S-transferase, glutathione peroxidase and superoxide dismutase (SOD) in wounded diabetic rats. CONCLUSIONS: WP was observed to enhance wound closure by improving the diabetic condition, limiting prolonged inflammation, suppressing oxidative stress and elevating the antioxidant defense system in diabetic rats.

Ehlayel, M., et al. (2011). "Camel milk is a safer choice than goat milk for feeding children with cow milk allergy." ISRN Allergy **2011**: 391641.

Background. Various sources of mammalian milk have been tried in CMA. Objectives. To determine whether camel milk is safer than goat milk in CMA. Methods. Prospective study conducted at Hamad Medical Corporation between April 2007 and April 2010, on children with CMA. Each child had medical examination, CBC, total IgE, cow milk-specific IgE and SPT. CMA children were tested against fresh camel and goat milks. Results. Of 38 children (median age 21.5 months), 21 (55.3%) presented with urticaria, 17 (39.5%) atopic dermatitis, 10 (26.3%) anaphylaxis. WBC was 10, 039 +/- 4, 735 cells/muL, eosinophil 1, 143 +/- 2, 213 cells/muL, IgE 694 +/- 921 IU/mL, cow's milk-specific-IgE 23.5 +/- 35.6 KU/L. Only 7 children (18.4%) tested positive to camel milk and 24 (63.2%) to goat milk. 6 (15.8%) were positive to camel, goat, and cow milks. Patients with negative SPT tolerated well camel and goat milks. Conclusions. In CMA, SPT indicates low cross-reactivity between camel milk and cow milk, and camel milk is a safer alternative than goat milk.

Ehlayel, M. S., et al. (2011). "Camel milk: an alternative for cow's milk allergy in children." <u>Allergy Asthma Proc</u> **32**(3): 255-258.

Treatment of cow's milk allergy (CMA) in children includes avoidance of cow's milk and providing a milk substitute. This study was designed to determine whether CMA children could safely consume camel's milk as an alternative, and skin-prick test (SPT) to camel's milk could be a reliable tool in selecting them. Between April 2007 and February 2010, children with confirmed CMA seen at the Allergy-Immunology Clinic, Hamad Medical Corp., were enrolled into this prospective cohort study. Subjects had a detailed history and medical examination, complete blood count with differential count, total serum IgE, and specific IgE test and SPT to cow's milk. Patients with positive SPT and an elevated cow's milk-specific IgE had negative SPT to camel's milk. Of 35 children (23 male and 12 female children) aged 4-126 months (median, 21 months), 23 patients (65.7%) presented with acute urticaria, 17 (48.6%) with atopic dermatitis, 9 (25.7%) with anaphylaxis, 8 (22.9%) with failure to thrive, and 5 (14.3%) with chronic vomiting. Twenty-eight patients (80%) had family history of allergy. Twenty-six patients (74.3%) were breast-fed for </=18 months. Mean white blood cell count was 9860.5 cells/muL, absolute eosinophil count was 1219 cells/muL, IgE was 682 IU/mL, and cow's milk-specific IgE was 22.01 kU/L. Only 7 patients (20%) had positive SPT to camel's milk and 28 (80%) were negative to camel's milk. All patients with negative SPT took camel's milk without any reactions. In children with CMA, SPT is a reliable clinical test in ruling out reactivity to camel's milk so these children could safely take camel's milk as an alternative nutrient.

Ejtahed, H. S., et al. (2015). "Effect of camel milk on blood sugar and lipid profile of patients with type 2 diabetes: a pilot clinical trial." <u>Int J Endocrinol Metab</u> **13**(1): e21160.

BACKGROUND: It has been shown that camel milk consumption has a definite decreasing effect on the prevalence of diabetes. However, most of these studies were conducted on patients with type 1 diabetes, whereas studies on patients with type 2 diabetes mellitus (T2DM) are limited. In vitro experiments have shown that camel milk was able to decrease blood glucose concentration. OBJECTIVES: The purpose of this study was to investigate effects of camel and cow milk on blood sugar, lipid profile, and blood pressure of patients with T2DM. PATIENTS AND METHODS: In a randomized single-blinded controlled clinical trial, 20 patients with T2DM were randomly allocated into two groups. Participants consumed 500 mL of either camel milk (intervention group) or cow milk (control group) daily for two months. RESULTS: Mean of insulin concentration was significantly increased from 64.59 to 84.03 pmol/L in the camel milk group during the study (P < 0.05). No significant differences were shown in fasting blood sugar, lipid profile, and blood pressure between the two groups at the end of study. There was significant increase in homeostasis model assessment of insulin resistance (HOMA-IR) during the study in both groups, but no significant difference was seen between the two groups. CONCLUSIONS: Camel milk increased insulin level in patients with T2DM and might contribute to glycemic control in T2DM.

El-Fakharany, E. M., et al. (2012). "Anti-infectivity of camel polyclonal antibodies against hepatitis C virus in Huh7.5 hepatoma." <u>Virol J</u> **9**: 201.

PURPOSE: To extend the study of the camel milk proteins which have antiviral activity against HCV, camel naive polyclonal IgGs, alpha-lactalbumin were purified from camel milk and their anti-HCV effect was examined using PBMCs and Huh7.5 cell-lines. They were compared with the activity of human polyclonal IgGs and camel lactoferrin and casein. MATERIAL AND METHODS: Three types of experiments were performed on PBMCs and HuH7.5 cell. HCV was directly incubated with the purified proteins and

then mixed with both cell types, or the proteins were incubated with the cells and then exposed to HCV, or the HCV pre-infected cells were treated with the proteins to inhibit intracellular replication. The proteins were added to cells or virus at different concentrations and time intervals. RESULTS: Pretreated PBMCs and Huh7.5 cells with milk proteins were not protected when exposed to HCV infection. The direct interaction between HCV and camel IgGs and camel lactoferrin (cLf) led to a complete inhibition of HCV entry into cells, while casein, alpha-lactalbumin and human IgGs failed to inhibit HCV entry at any tested concentration. Camel IgGs showed ability to recognize HCV peptides with a significant titer (12 x 10(3)) in comparison with human IgGs which failed to do it. Camel lactoferrin was capable of inhibiting the intracellular HCV replication at concentrations of 0.25-1.25 mg/ml. CONCLUSION: Camel milk naive polyclonal IgGs isolated from camel milk could inhibit the HCV infectivity and demonstrated strong signal against its synthetic peptides. Lactoferrin inhibit the HCV infectivity started from 0.25 mg/ml. However, alpha-lactalbumin, human IgGs and casein failed to demonstrate any activity against HCV infectivity.

Elamin, E. A., et al. (1992). "Prevalence of Toxoplasma gondii antibodies in pastoral camels (Camelus dromedarius) in the Butana plains, mid-Eastern Sudan." Vet Parasitol **43**(3-4): 171-175.

A total of 482 serum samples from pastoral camels in the Butana plains, mid-Eastern Sudan, were tested for Toxoplasma antibodies by the latex agglutination test (LAT). Sixty-seven percent of the camels were seroreactive. The prevalence rate of seroreactivity increased significantly with age (P less than 0.01) and was highest among camels aged over 7 years (74.2%). The prevalence rate of seropositivity decreased proportionally with the level of serum dilution. At dilutions of 1:32 and above, the prevalence rate was 25.9%. There were no sex-linked differences in seroreactivity. This study suggests widespread infection with Toxoplasma gondii among pastoral camels, a finding that warrants a closer look into the possible ways infection is acquired by camels in their arid environment, its economic impact, as well as its public health significance, especially among the nomads who consume cameline milk and liver raw.

Fanoy, E. B., et al. (2014). "Travel-related MERS-CoV cases: an assessment of exposures and risk factors in a group of Dutch travellers returning from the Kingdom of Saudi Arabia, May 2014." Emerg Themes Epidemiol **11**: 16.

BACKGROUND: In May 2014, Middle East respiratory syndrome coronavirus (MERS-CoV) infection, with closely related viral genomes, was diagnosed in two Dutch residents, returning from a pilgrimage to Medina and Mecca, Kingdom of Saudi Arabia (KSA). These patients travelled with a group of 29 other Dutch travellers. We conducted an epidemiological assessment of the travel group to identify likely source(s) of infection and presence of potential risk factors. METHODS: All travellers, including the two cases, completed a questionnaire focussing on potential human, animal and food exposures to MERS-CoV. The questionnaire was modified from the WHO MERS-CoV questionnaire, taking into account the specific route and activities of the travel group. RESULTS: Twelve non-cases drank unpasteurized camel milk and had contact with camels. Most travellers, including one of the two patients (Case 1), visited local markets, where six of them consumed fruits. Two travellers, including Case 1, were exposed to coughing patients when visiting a hospital in Medina. Four travellers, including Case 1, visited two hospitals in Mecca. All travellers had been in contact with Case 1 while he was sick, with initially non-respiratory complaints. The cases were found to be older than the other travellers and both had co-morbidities. CONCLUSIONS: This epidemiological study revealed the complexity of MERS-CoV outbreak investigations with multiple potential exposures to MERS-CoV reported such as healthcare

visits, camel exposure, and exposure to untreated food products. Exposure to MERS-CoV during a hospital visit is considered a likely source of infection for Case 1 but not for Case 2. For Case 2, the most likely source could not be determined. Exposure to MERS-CoV via direct contact with animals or dairy products seems unlikely for the two Dutch cases. Furthermore, exposure to a common but still unidentified source cannot be ruled out. More comprehensive research into sources of infection in the Arabian Peninsula is needed to strengthen and specify the prevention of MERS-CoV infections.

Funk, A. L., et al. (2016). "MERS-CoV at the Animal-Human Interface: Inputs on Exposure Pathways from an Expert-Opinion Elicitation." Front Vet Sci **3**: 88.

Nearly 4 years after the first report of the emergence of Middle-East respiratory syndrome Coronavirus (MERS-CoV) and nearly 1800 human cases later, the ecology of MERS-CoV, its epidemiology, and more than risk factors of MERS-CoV transmission between camels are poorly understood. Knowledge about the pathways and mechanisms of transmission from animals to humans is limited; as of yet, transmission risks have not been quantified. Moreover the divergent sanitary situations and exposures to animals among populations in the Arabian Peninsula, where human primary cases appear to dominate, vs. other regions in the Middle East and Africa, with no reported human clinical cases and where the virus has been detected only in dromedaries, represents huge scientific and health challenges. Here, we have used expert-opinion elicitation in order to obtain ideas on relative importance of MERS-CoV risk factors and estimates of transmission risks from various types of contact between humans and dromedaries. Fourteen experts with diverse and extensive experience in MERS-CoV relevant fields were enrolled and completed an online questionnaire that examined pathways based on several scenarios, e.g., camels-camels, camels-human, bats/other species to camels/humans, and the role of diverse biological substances (milk, urine, etc.) and potential fomites. Experts believed that dromedary camels play the largest role in MERS-CoV infection of other dromedaries; however, they also indicated a significant influence of the season (i.e. calving or weaning periods) on transmission risk. All experts thought that MERS-CoV-infected dromedaries and asymptomatic humans play the most important role in infection of humans, with bats and other species presenting a possible, but yet undefined, risk. Direct and indirect contact of humans with dromedary camels were identified as the most risky types of contact, when compared to consumption of various camel products, with estimated "most likely" incidence risks of at least 22 and 13% for direct and indirect contact, respectively. The results of our study are consistent with available, yet very limited, published data regarding the potential pathways of transmission of MERS-CoV at the animal-human interface. These results identify key knowledge gaps and highlight the need for more comprehensive, yet focused research to be conducted to better understand transmission between dromedaries and humans.

Garbaj, A. M., et al. (2016). "Enterohemorrhagic Escherichia coli O157 in milk and dairy products from Libya: Isolation and molecular identification by partial sequencing of 16S rDNA." Vet World **9**(11): 1184-1189.

AIM: The aim of this work was to isolate and molecularly identify enterohemorrhagic Escherichia coli (EHEC) O157 in milk and dairy products in Libya, in addition; to clear the accuracy of cultural and biochemical identification as compared with molecular identification by partial sequencing of 16S rDNA for the existing isolates. MATERIALS AND METHODS: A total of 108 samples of raw milk (cow, she-camel, and goat) and locally made dairy products (fermented cow's milk, Maasora, Ricotta and ice cream) were collected from some regions (Janzour, Tripoli, Kremiya, Tajoura and Tobruk) in Libya. Samples were subjected to microbiological analysis for isolation of E. coli that was detected by conventional cultural

and molecular method using polymerase chain reaction and partial sequencing of 16S rDNA. RESULTS: Out of 108 samples, only 27 isolates were found to be EHEC O157 based on their cultural characteristics (Tellurite-Cefixime-Sorbitol MacConkey) that include 3 isolates from cow's milk (11%), 3 isolates from she-camel's milk (11%), two isolates from goat's milk (7.4%) and 7 isolates from fermented raw milk samples (26%), isolates from fresh locally made soft cheeses (Maasora and Ricotta) were 9 (33%) and 3 (11%), respectively, while none of the ice cream samples revealed any growth. However, out of these 27 isolates, only 11 were confirmed to be E. coli by partial sequencing of 16S rDNA and E. coli O157 Latex agglutination test. Phylogenetic analysis revealed that majority of local E. coli isolates were related to E. coli O157:H7 FRIK944 strain. CONCLUSION: These results can be used for further studies on EHEC O157 as an emerging foodborne pathogen and its role in human infection in Libya.

Garcell, H. G., et al. (2016). "Outbreaks of brucellosis related to the consumption of unpasteurized camel milk." J Infect Public Health **9**(4): 523-527.

Brucellosis is the most frequent zoonosis reported in Qatar, mainly related to exposure to infected camels. An outbreak of human brucellosis in 14 members of a family living in a rural area in Qatar is reported herein. Clinical, epidemiological and laboratory results from all 14 patients with Brucella and 12 non-confirmed family members were collected from files. All patients reported fever for a maximum of 14 days, associated with arthralgia (6 patients), weakness (4 patients), headache (4 patients), diarrhea (2 patients) and abdominal pain (2 patients). The median age of the patients was 10 years and that of non-cases was 16 years, with a predominance of males (92.9%). Elevated levels of transaminases were observed in patients. A mixed infection caused by Brucella abortus and Brucella melitensis was identified by blood culture and serology. The source of the infection was the milk of an infected camel. The outbreak of brucellosis melitensis/abortus related to the consumption of camel milk constitutes a gap in the prevention and control of the potential sources of brucellosis in animal farms. Proper control and education of the population are required.

Gautret, P., et al. (2013). "Camel milk-associated infection risk perception and knowledge in French Hajj pilgrims." Vector Borne Zoonotic Dis **13**(6): 425-427.

Cases of brucellosis have been recently reported in Hajj pilgrims following camel milk consumption. With the aim of evaluating French pilgrim's potential risk for raw camel milk-associated diseases, we conducted a knowledge, attitude, and practice study among 331 pilgrims departing to the 2011 Hajj. A proportion of 8.2% have drunk camel milk before, mostly in North Africa (62.9%) and Saudi Arabia (18.5%). A proportion of 13.9% declared they knew that drinking raw camel milk could cause diseases and 40.6% said that they would drink it if offered during the pilgrimage. Given that camel milk consumption in the Middle East is associated with several zoonotic infections in man, we recommend that Hajj pilgrims be cautioned against consuming unpasteurized dairy products.

Gautret, P., et al. (2013). "Preventive measures against MERS-CoV for Hajj pilgrims." Lancet Infect Dis **13**(10): 829-831.

Gebremedhin, E. Z., et al. (2016). "Toxoplasmosis in camels (Camelus dromedarius) of Borana zone, Oromia region, Ethiopia: seroprevalence and risk factors." Trop Anim Health Prod **48**(8): 1599-1606.

Toxoplasmosis is one of the most prevalent parasitic infections of medical and veterinary importance. A cross-sectional study was conducted from November 2013 to January 2014 to estimate the seroprevalence of Toxoplasma gondii infection in camels from four districts of Borana zone, Southern Oromia, Ethiopia. In addition, a questionnaire survey was administered to 124 pastoralists to identify possible risk factors and to assess the awareness level of pastoral communities about toxoplasmosis. A total of 396 serum samples were examined for anti-Toxoplasma IgG antibodies using the direct agglutination test (DAT). Fisher's exact test and logistic regression were used for data analysis. An overall seroprevalence of 8.33 % (95 % confidence interval [CI] 5.60 %, 11.07 %) at animal-level and 37.5 % (95 % CI: 20.1 %, 57.4 %) at herd-level was found. The seroprevalence was significantly high in Moyale district (23.07 %) followed by Yabello (7.20 %), Dirre (3.77 %), and Arero (0.0 %) districts (P < 0.001). Multivariable logistic regression analysis revealed that the likelihood of acquiring T. gondii infection was significantly higher in camels of Moyale district (adjusted OR = 5.89, 95 % CI 2.15, 16.12; P = 0.001) than Dirre district, in camels of >8 years old (adjusted odds ratio [OR] = 4.95, 95 % CI 1.68, 14.55; P = 0.004) than camels of </=4 years old. There was no significant association between herd-level seroprevalence of T. gondii infection and abortion history, herd size, and presence of domestic cats and wild felids (P > 0.05). The majority of interviewees were uneducated (82.25 %), and all had no knowledge of toxoplasmosis. All camel herders drink raw camel milk but consume cooked meat (90.32 %). Of the interviewees, 93.06 % are aware about soil-eating habit of camels and provide salt supplement for their camels. Majority of the respondents practice improper disposal of aborted materials (throw along the way) (88.70 %), and 73 % of the study participants do not wash their hands after handling aborted fetus. The results of the present study confirm relatively lower prevalence of T. gondii infection in camels reared in Borana zone. Age and study district are significant predictors of T. gondii seropositivity. The vast majorities of interviewed pastoralists were uneducated and practice poor biosecurity measures to prevent diseases. Education of pastoralists about biosecurity measures to prevent toxoplasmosis and further studies are warranted to unravel the economic and public health consequences of T. gondii infection.

Gebremedhin, E. Z., et al. (2014). "First report of Toxoplasma gondii in camels (Camelus dromedarius) in Ethiopia: bioassay and seroepidemiological investigation." BMC Vet Res **10**: 222.

BACKGROUND: Toxoplasmosis is a major public health concern in many countries of the world. A cross-sectional and follow up experimental study designs were used for seroepidemiological and bioassay studies, respectively from November 2012 to April 2013. The objectives were to estimate the seroprevalence of T. gondii infection, to assess risk factors and to isolate the parasite from camels in the Fentale district, Ethiopia. A direct agglutination test (DAT) and indirect enzyme linked immunosorbent assay (ELISA) kits were used to test camel sera. Hearts and tongues (each 25 g) from 31 seropositive camels were bioassayed in mice. Associations between seroprevalence and potential risk factors (collected using a questionnaire survey) were analyzed using logistic regression. RESULTS: An overall T. gondii prevalence of 49.62% (220/455) by DAT and 40.49% (179/451) by indirect ELISA test were detected. Herd level seroprevalence of 96.77% (30/31) (95% CI: 83.30- 99.92) by DAT was recorded and it was significantly higher in areas where wild felids are present (P = 0.038). Multivariable logistic regression showed that the likelihood of acquiring T. gondii infection was significantly higher in camels in the Ilala pastoral association [PA] (82.26%) (Adjusted Odds ratio [aOR] = 10.8; P < 0.001) than camels in the Galcha PA (31.43%), in camels of >/= 8 years old (56.52%; aOR = 1.88; P = 0,033) than camels of </= 4 years old (34.26%) and in areas where domestic cats are present (aOR = 4.16; P = 0.006). All camel owners were uneducated, handle aborted fetus with bare hands, and drink raw camel milk. DAT and ELISA tests had moderate agreement (Kappa = 0.41). Viable T. gondii were isolated from 16.13% (5/31)

of DAT positive camels. One DAT positive but ELISA negative camel sample gave a cyst positive result. CONCLUSIONS: T. gondii infection of camels in the study district is widespread. Age, presence of domestic cats and study PA are independent predictors of T. gondii seropositivity. Isolation of viable parasites from edible tissues of camels and the very poor knowledge of pastoralists about toxoplasmosis suggest the need for prevention of toxoplasmosis through bio-security measures, education and further investigation to unravel the impact of camel toxoplasmosis deserves consideration.

Gossner, C., et al. (2016). "Human-Dromedary Camel Interactions and the Risk of Acquiring Zoonotic Middle East Respiratory Syndrome Coronavirus Infection." Zoonoses Public Health **63**(1): 1-9.

Middle East respiratory syndrome coronavirus (MERS-CoV) cases without documented contact with another human MERS-CoV case make up 61% (517/853) of all reported cases. These primary cases are of particular interest for understanding the source(s) and route(s) of transmission and for designing long-term disease control measures. Dromedary camels are the only animal species for which there is convincing evidence that it is a host species for MERS-CoV and hence a potential source of human infections. However, only a small proportion of the primary cases have reported contact with camels. Other possible sources and vehicles of infection include food-borne transmission through consumption of unpasteurized camel milk and raw meat, medicinal use of camel urine and zoonotic transmission from other species. There are critical knowledge gaps around this new disease which can only be closed through traditional field epidemiological investigations and studies designed to test hypothesis regarding sources of infection and risk factors for disease. Since the 1960s, there has been a radical change in dromedary camel farming practices in the Arabian Peninsula with an intensification of the production and a concentration of the production around cities. It is possible that the recent intensification of camel herding in the Arabian Peninsula has increased the virus' reproductive number and attack rate in camel herds while the 'urbanization' of camel herding increased the frequency of zoonotic 'spillover' infections from camels to humans. It is reasonable to assume, although difficult to measure, that the sensitivity of public health surveillance to detect previously unknown diseases is lower in East Africa than in Saudi Arabia and that sporadic human cases may have gone undetected there.

Goudah, A., et al. (2008). "Concentration-time courses of pefloxacin in plasma and milk of lactating she-camels (Camelus dromedarius)." Berl Munch Tierarztl Wochenschr **121**(11-12): 432-439.

Using the microbial inhibition test, the single-dose pharmacokinetics of pefloxacin mesylate dehydrate were studied in six clinically normal lactating she-camels (Camelus dromedarius) after intravenous (IV) and intramuscular (IM) administration of 10 mg/kg body weight (bwt). Blood and milk samples were collected intermittently for a 48 h period, and the pharmacokinetic variables were calculated using compartmental and non-compartmental analytical methods.The plasma course of pefloxacin was best resolved to a two-compartment open model after IV administration and a two-compartment open model with first-order absorption after IM administration. Pefloxacin exhibits a long elimination-phase disposition half-life (t1/2beta) of 4.89 +/- 1.12 h after IV injection and 5.73 +/- 1.42 h after IM administration. The mean volume of distribution at steady state (Vdss) and total body clearance (Cl(tot)) values after IV dosing were 1.18 +/- 0.45 I/kg and 0.21 +/- 0.10 I/kg/h, respectively. The observed peak plasma level (Cmax) of 3.6 +/- 0.1 microg/ml was rapidly attained at 0.75 h (the time of maximum concentration Tmax) after IM administration. The areas under the concentration versus time curves (AUCs) were 44.18 +/- 9.68 microg x h/ml and 29.42 +/-6.49 microg x h/ml after IV and IM administration, respectively. The absolute bioavailability (F%) obtained after IM administration was

71.59 +/- 12.45%. Milk was penetrated quickly, with a mean peak level of 3.24 +/- 0.17 microg/ml occurring at 1.0 h. The elimination half-life was significantly shorter after IV versus IM administration (4.21 +/- 0.84 h versus 5.32 +/- 0.67 h, respectively). Ultimately, pefloxacin could be useful for treatment of udder infections in she-camels after specific assessment of susceptible microorganisms.

Guliye, A. Y., et al. (2002). "Detection of subclinical mastitis in dromedary camels (Camelus dromedarius) using somatic cell counts and the N-acetyl-beta-D-glucosaminidase test." Trop Anim Health Prod **34**(2): 95-104.

Somatic cell counts, N-acetyl-beta-D-glucosaminidase (NAGase) activity and the infection status of the udder were determined in quarter milk samples (n = 86) from 22 multiparous, clinically healthy camels, traditionally managed by Bedouin nomads in the Negev desert, Israel. Seventy (81.4%) of the 86 samples examined contained bacteria, of which 35 (40.7%) gave mixed isolations of two or more bacteria, suggesting the existence of subclinical mastitis in the camel herds studied. Sixteen samples (18.6%) yielded no growth of bacteria. Staphylococcus aureus, Micrococcus spp., Bacillus spp., Streptococcus dysgalactiae and Escherichia coli were the main organisms isolated. The somatic cell count (SCC) ranged from 1.01 x 105 to 11.78 x 106 cells/ml. NAGase values were between 41.4 and 372 NAGase units. Quarter milk samples that contained bacteria had significantly (p < 0.01) higher mean values for SCC but the mean NAGase levels were not significantly different for the bacteriologically negative and positive samples. There was a low correlation coefficient (r2 = 0.097) between the SCC and NAGase in the quarter milk samples from which bacteria were not isolated (n = 16) and a low negative correlation (r2 = -0.038) with the samples that contained bacteria (n = 70). The type of bacteria had a significant effect (p < 0.01) on the SCC but not on the NAGase activity. Quarter samples from which Staphylococcus aureus (coagulase positive) was isolated showed the highest mean SCC and this organism is therefore suspected to be the underlying cause of the subclinical mastitis. The SCC gave a better indication of the presence of pathogenic microorganisms in milk samples than did NAGase.

Gustafsson, A., et al. (2005). "Carbohydrate phenotyping of human and animal milk glycoproteins." Glycoconj J **22**(3): 109-118.

Breast-milk has a well-known anti-microbial effect, which is in part due to the many different carbohydrate structures expressed. This renders it a position as a potential therapeutic for treatment of infection by different pathogens, thus avoiding the drawbacks of many antibiotics. The plethora of carbohydrate epitopes in breast-milk is known to differ between species, with human milk expressing the most complex one. We have investigated the expression of protein-bound carbohydrate epitopes in milk from man, cow, goat, sheep, pig, horse, dromedary and rabbit. Proteins were separated by SDS-PAGE and the presence of carbohydrate epitopes on milk proteins were analysed by Western blotting using different lectins and carbohydrate-specific antibodies. We show that ABH, Lewis (Le)x, sialyl-Lex, Lea, sialyl-Lea and Leb carbohydrate epitopes are expressed mainly on man, pig and horse milk proteins. The blood group precursor structure H type 1 is expressed in all species investigated, while only pig, dromedary and rabbit milk proteins carry H type 2 epitopes. These epitopes are receptors for Helicobacter pylori (Leb and sialyl-Lex), enteropathogenic (H type 1, Lea and Lex) and enterotoxic Escherichia coli (heat-stable toxin; H type 1 and 2), and Campylobacter jejuni (H type 2). Thus, milk from these animals or their genetically modified descendants could have a therapeutic effect by inhibiting pathogen colonization and infection.

Gwida, M., et al. (2012). "Brucellosis in camels." Res Vet Sci **92**(3): 351-355.

Camels are highly susceptible to brucellosis caused by Brucella melitensis and Brucella abortus. Difficulties can arise in diagnosis of camel brucellosis, especially as this disease provokes only few clinical signs in contrast to its clinical course in cattle. Because none of the commonly used serological test can be perceived as a perfect test for Brucella diagnosis in camel and most serological tests used for camels have been directly transposed from cattle without adequate validation, an incorrect diagnosis may occur when diagnosis is based on serology alone. Of imminent concern is the fact that brucellosis can be easily transmitted from animals or their products to humans mainly via milk. In many developing countries in the arid areas of Asia and Africa, camels are still the most important productive livestock for nomadic populations. Therefore, we reviewed the literatures on camel brucellosis to highlight the epidemiologic, economic and public health impact of camel brucellosis as a basis for designing effective control strategies.

Gyuranecz, M., et al. (2016). "Genotyping of Brucella melitensis strains from dromedary camels (Camelus dromedarius) from the United Arab Emirates with multiple-locus variable-number tandem repeat analysis." Vet Microbiol **186**: 8-12.

Camel brucellosis is a widespread zoonotic disease in camel-rearing countries caused by Brucella melitensis and Brucella abortus. The aim of this study was the first genetic analysis of B. melitensis strains isolated from dromedary camels (Camelus dromedarius) using multiple-locus variable-number tandem repeat analysis (MLVA). MLVA 16 and its MLVA 8 and MLVA11 subsets were used to determine the genotypes of 15 B. melitensis isolates from dromedary camels (11 strains) and other host species (4 strains) from the United Arab Emirates and the results were then compared to B. melitensis MLVA genotypes from other parts of the world. Five, including two novel genotypes were identified with MLVA 8. MLVA 16 further discriminated these five genotypes to ten variants. The eleven camel isolates clustered into four main genetic groups within the East-Mediterranean and African clades and this clustering correlated with the geographic origin of the hosts (United Arab Emirates, Kingdom of Saudi Arabia and Sudan) and the date of their isolation. The camel strains were also genetically related to strains isolated from wild and domestic ruminants from their close habitat or from other parts of the world. Although limited number of strains were analysed, based on our data imported animals from foreign countries, local small ruminants and wildlife species are hypothesized to be the main sources of camel brucellosis in the United Arab Emirates. MLVA was successfully applied to determine the epidemiological links between the different camel B. melitensis infections in the United Arab Emirates and it can be a beneficial tool in future disease control programs.

Habib, H. M., et al. (2013). "Camel milk lactoferrin reduces the proliferation of colorectal cancer cells and exerts antioxidant and DNA damage inhibitory activities." Food Chem **141**(1): 148-152.

Lactoferrin (Lf), the main iron-binding protein of milk, has biological activities. We have evaluated the potential of camel milk lactoferrin for its ability to inhibit the proliferation of the colon cancer cell line, HCT-116, in vitro, DNA damage and its antioxidant activities for the first time. The antioxidant capacity of Lf was evaluated by different assays, including ferric-reducing/antioxidant power assay (FRAP), free radical-scavenging activity (DPPH), nitric oxide (NO) radical-scavenging assay, total antioxidant activity and DNA damage, compared with vitamin C and rutin.

Hasson, S. S., et al. (2015). "In Vitro Apoptosis Triggering in the BT-474 Human Breast Cancer Cell Line by Lyophilised Camel's Milk." Asian Pac J Cancer Prev **16**(15): 6651-6661.

Breast cancer is a global health concern and is a major cause of death among women. In Oman, it is the most common cancer in women, with an incidence rate of 15.6 per 100,000 Omani females. Various anticancer remedies have been discovered from natural products in the past and the search is continuing for additional examples. Cytotoxic natural compounds may have a major role in cancer therapy either in potentiating the effect of chemotherapy or reducing its harmful effects. Recently, a few studies have reported advantages of using crude camel milk in treating some forms of cancer. However, no adequate data are available on the lyophilised camel's milk responsibility for triggering apoptosis and oxidative stress associated with human breast cancer. The present study aimed to address the role of the lyophilised camel's milk in inducing proliferation repression of BT-474 and HEp-2 cells compared with the non-cancer HCC1937 BL cell line. Lyophilized camel's milk fundamentally repressed BT-474 cells growth and proliferation through the initiation of either the intrinsic and extrinsic apoptotic pathways as indicated by both caspase-3 mRNA and its action level, and induction of death receptors in BT-474 but not the HEp-2 cell line. In addition, lyophilised camel's milk enhanced the expression of oxidative stress markers, heme-oxygenase-1 and reactive oxygen species production in BT-474 cells. Increase in caspase-3 mRNA levels by the lyophilised camel's milk was completely prevented by the actinomycin D, a transcriptional inhibitor. This suggests that lyophilized camel's milk increased newly synthesized RNA. Interestingly,it significantly (p<0.003) repressed the growth of HEp-2 cells and BT-474 cells after treatment for 72 hours while 24 hours treatment repressed BT-474 cells alone. This finding suggests that the lyophilised camel's milk might instigate apoptosis through initiation of an alternative apoptotic pathway.

Hiepe, T. (1988). "Advances in control of ectoparasites in large animals." Angew Parasitol **29**(4): 201-210.

In continuation of a publication on "Large-scale management systems and parasite populations: ectoparasites" in Vet. Parasitol. 11 (1982): 61-68, advances and present state of the control of ectoparasites in herds of cattle, sheep and camels are discussed. An intensified animal production necessitates permanent veterinary control of the status of ectoparasites. Strategically, control is basically directed towards achieving three aims: eradication, reduction of losses by means of dilution of ectoparasites regulations, and therapeutic measures. In the last few years, important progress has been made in effective ectoparasites control, mainly resulting from the discovery of new insecticides and acaricides, the improvement of the application techniques and the recent results in the biological control of arthropods; finally, an immunological approach will open new alternative ways of control. The control of mange and demodicosis in cattle; sarcoptic mange and sucking lice infestations in pigs; mange, biting lice infestations and nasal bots in sheep; ectoparasite infestations in camels and tick infestations are the main topics of the paper. The discovery of Ivermectin, a derivate of Streptomyces avermitilis which is now already fully integrated in to the spectrum of antiparasitic drugs, created a new generation of broad spectrum insecticides/acaricides. Current problems of the chemical control of arthropods, like the risk of residues in meat, milk and their products, the insecticide resistance and the possible environment pollution are critically outlined. But on the other hand, it can be predicted hypothetically that the amount of pest control measures in farm animals will increase in the near future to eliminate arthropods as causes of skin diseases and of damages to hides entailing negative effects on leather processing and as vectors of important infection agents. Finally, the proposal is submitted to elaborate international control programmes against ectoparasite species of global importance.

Jans, C., et al. (2013). "Comparative genome analysis of Streptococcus infantarius subsp. infantarius CJ18, an African fermented camel milk isolate with adaptations to dairy environment." BMC Genomics **14**: 200.

BACKGROUND: Streptococcus infantarius subsp. infantarius (Sii) belongs to the Streptococcus bovis/Streptococcus equinus complex associated with several human and animal infections. Sii is a predominant bacterium in spontaneously fermented milk products in Africa. The genome sequence of Sii strain CJ18 was compared with that of other Streptococcus species to identify dairy adaptations including genome decay such as in Streptococcus thermophilus, traits for its competitiveness in spontaneous milk fermentation and to assess potential health risks for consumers. RESULTS: The genome of Sii CJ18 harbors several unique regions in comparison to Sii ATCC BAA-102T, among others an enlarged exo- and capsular polysaccharide operon; Streptococcus thermophilus-associated genes; a region containing metabolic and hypothetical genes mostly unique to CJ18 and the dairy isolate Streptococcus gallolyticus subsp. macedonicus; and a second oligopeptide transport operon. Dairy adaptations in CJ18 are reflected by a high percentage of pseudogenes (4.9%) representing genome decay which includes the inactivation of the lactose phosphotransferase system (lacIIABC) by multiple transposases integration. The presence of lacS and lacZ genes is the major dairy adaptation affecting lactose metabolism pathways also due to the disruption of lacIIABC.We constructed mutant strains of lacS, lacZ and lacIIABC and analyzed the resulting strains of CJ18 to confirm the redirection of lactose metabolism via LacS and LacZ.Natural competence genes are conserved in both Sii strains, but CJ18 contains a lower number of CRISPR spacers which indicates a reduced defense capability against alien DNA. No classical streptococcal virulence factors were detected in both Sii strains apart from those involved in adhesion which should be considered niche factors. Sii-specific virulence factors are not described. Several Sii-specific regions encoding uncharacterized proteins provide new leads for virulence analyses and investigation of the unclear association of dairy and clinical Sii with human diseases. CONCLUSIONS: The genome of the African dairy isolate Sii CJ18 clearly differs from the human isolate ATCC BAA-102T. CJ18 possesses a high natural competence predisposition likely explaining the enlarged genome. Metabolic adaptations to the dairy environment are evident and especially lactose uptake corresponds to S. thermophilus. Genome decay is not as advanced as in S. thermophilus (10-19%) possibly due to a shorter history in dairy fermentations.

Jans, C., et al. (2012). "Novel Streptococcus infantarius subsp. infantarius variants harboring lactose metabolism genes homologous to Streptococcus thermophilus." Food Microbiol **31**(1): 33-42.

Streptococcus infantarius subsp. infantarius belongs to the Streptococcus bovis/Streptococcus equinus complex (SBSEC) commonly associated with human and animal infections. We elucidated the lactose metabolism of S. infantarius subsp. infantarius predominant in African fermented milk products. S. infantarius subsp. infantarius isolates (n = 192) were identified in 88% of spontaneously fermented camel milk suusac samples (n = 24) from Kenya and Somalia at log(1)(0) 8.2-8.5 CFU mL(-)(1). African S. infantarius isolates excreted stoichiometric amounts of galactose when grown on lactose, exhibiting a metabolism similar to Streptococcus thermophilus and distinct from their type strain. African S. infantarius subsp. infantarius CJ18 harbors a regular gal operon with 99.7-100% sequence identity to S. infantarius subsp. infantarius ATCC BAA-102(T) and a gal-lac operon with 91.7-97.6% sequence identity to S. thermophilus, absent in all sequenced SBSEC strains analyzed. The expression and functionality of lacZ was demonstrated in a beta-galactosidase assay. The gal-lac operon was identified in 100% of investigated S. infantarius isolates (n = 46) from suusac samples and confirmed in Malian fermented cow milk isolates. The African S. infantarius variant potentially evolved through horizontal gene transfer of an

S. thermophilus-homologous lactose pathway. Safety assessments are needed to identify any putative health risks of this novel S. infantarius variant.

Jans, C., et al. (2013). "Prevalence and comparison of Streptococcus infantarius subsp. infantarius and Streptococcus gallolyticus subsp. macedonicus in raw and fermented dairy products from East and West Africa." Int J Food Microbiol **167**(2): 186-195.

Streptococcus infantarius subsp. infantarius (Sii) and Streptococcus gallolyticus subsp. macedonicus are members of the Streptococcus bovis/Streptococcus equinus complex (SBSEC) associated with human infections. SBSEC-related endocarditis was furthermore associated with rural residency in Southern Europe. SBSEC members are increasingly isolated as predominant species from fermented dairy products in Europe, Asia and Africa. African variants of Sii displayed dairy adaptations to lactose metabolism paralleling those of Streptococcus thermophilus including genome decay. In this study, the aim was to assess the prevalence of Sii and possibly other SBSEC members in dairy products of East and West Africa in order to identify their habitat, estimate their importance in dairy fermentation processes and determine geographic areas affected by this potential health risk. Presumptive SBSEC members were isolated on semi-selective M17 and SM agar media. Subsequent genotypic identification of isolates was based on rep-PCR fingerprinting and SBSEC-specific16S rRNA gene PCR assay. Detailed identification was achieved through application of novel primers enhancing the binding stringency in partial groES/groEL gene amplification and subsequent DNA sequencing. The presence of S. thermophilus-like lacS and lacZ genes in the SBSEC isolates was determined to elucidate the prevalence of this dairy adaptation. Isolates (n = 754) were obtained from 72 raw and 95 fermented milk samples from Cote d'Ivoire and Kenya on semi-selective agar media. Colonies of Sii were not detected from raw milk despite high microbial titers of approximately 10(6)CFU/mL on M17 agar medium. However, after spontaneous milk fermentation Sii was genotypically identified in 94.1% of Kenyan samples and 60.8% of Kenyan isolates. Sii prevalence in Cote d'Ivoire displayed seasonal variations in samples from 32.3% (June) to 40.0% (Dec/Jan) and isolates from 20.5% (June) to 27.7% (Dec/Jan) present at titers of 10(6)-10(8)CFU/mL. lacS and lacZ genes were detected in all Kenyan and 25.8% (June) to 65.4% (Dec/Jan) of Ivorian Sii isolates. Regional differences in prevalence of Sii and dairy adaptations were observed, but no clear effect of dairy animal, fermentation procedure and climate was revealed. Conclusively, the high prevalence of Sii in Kenya, Cote d'Ivoire in addition to Somalia, Sudan and Mali strongly indicates a pivotal role of Sii in traditional African dairy fermentations potentially paralleling that of typical western dairy species S. thermophilus. Putative health risks associated with the consumption of high amounts of live Sii and potential different degrees of evolutionary adaptation or ecological colonization require further epidemiologic and genomic investigations, particularly in Africa.

Jezek, Z., et al. (1983). "Camelpox and its risk to the human population." J Hyg Epidemiol Microbiol Immunol **27**(1): 29-42.

Camelpox is mainly of economic importance due to its relatively high mortality, loss of condition and fall in milk production and weight of affected camels. Clinically, two distinct types can be distinguished: the severe, generalized form, which appeared more frequently among young animals and the milder, localized form encountered more often in older camels. A higher incidence of illness and a twice higher case fatality rate were observed among male camels. Deaths occurred in 30% of the observed outbreaks with the highest case fatality in a single outbreak being 28%. Electron microscopy was found to be the most reliable test for detection of poxviruses in skin specimens taken from diseased animals. From the 465 camel herdsmen handling affected camels, the majority of whom were

unvaccinated against smallpox, only a few developed skin eruptions. All skin specimens taken from them remained negative for poxviruses. From 335 specimens taken from skin lesions of persons who might come into direct or indirect contact with diseased animals, none was found to be positive for poxviruses. From an estimated 20 000 persons at risk, only one report of a possible case of human camelpox, which remained laboratory unconfirmed, was received. A few thousand camel herdsmen and their family members, interviewed in observed enzootic areas, strongly believed that camelpox is not transmissible to man. Although there have been reports in previous literature that man can be infected through handling affected camels, experience during the smallpox eradication campaign in Somalia in 1978-1979 suggests that human camelpox very rarely, if ever, occurs.

Kanwar, J. R., et al. (2015). "Multifunctional iron bound lactoferrin and nanomedicinal approaches to enhance its bioactive functions." Molecules **20**(6): 9703-9731.

Lactoferrin (Lf), an iron-binding protein from the transferrin family has been reported to have numerous functions. Even though Lf was first isolated from milk, it is also found in most exocrine secretions and in the secondary granules of neutrophils. Antimicrobial and anti-inflammatory activity reports on lactoferrin identified its significance in host defense against infection and extreme inflammation. Anticarcinogenic reports on lactoferrin make this protein even more valuable. This review is focused on the structural configuration of iron-containing and iron-free forms of lactoferrin obtained from different sources such as goat, camel and bovine. Apart for emphasizing on the specific beneficial properties of lactoferrin from each of these sources, the general antimicrobial, immunomodulatory and anticancer activities of lactoferrin are discussed here. Implementation of nanomedicinial strategies that enhance the bioactive function of lactoferrin are also discussed, along with information on lactoferrin in clinical trials.

Katz, Y., et al. (2008). "Cross-sensitization between milk proteins: reactivity to a "kosher" epitope?" Isr Med Assoc J **10**(1): 85-88.

BACKGROUND: Immunoglobulin E-mediated allergy to cow's milk protein represents a major problem for infants who are not breast fed. A search for substitute milks revealed a cross-allergenicity to milk derived from goat and sheep but not to milk from a mare. We noted that the cow, goat and sheep species are both artiodactyls and ruminants, defining them as kosher animals, in contrast to the mare. OBJECTIVES: To determine whether patients with IgE-mediated cow's milk allergy are cross-sensitized to milk from other species such as the deer, ibex, buffalo, pig and camel. METHODS: Patients with a clinical history consistent with IgE-mediated cow's milk protein allergy were tested by skin-prick test to validate the diagnosis. They were then evaluated by skin-prick test for cross-sensitization to milk-derived proteins from other species. RESULTS: All patients allergic to cow's milk tested positive by skin-prick test for cross-reactivity to deer, Ibex and buffalo (n = 24, P = 0). In contrast, only 5 of the 24 patients (20.83%) tested positive to pig milk and only 2 of 8 (25%) to camel's milk. Cross-sensitization to soy milk was noted in 4 of 23 patients (17.39%), although they all tolerated oral ingestion of soy-containing foods. CONCLUSIONS: A significant cross-sensitization to milk proteins derived from kosher animals exists in patients allergic to cow's milk protein, but far less so compared to the milk proteins from non-kosher animals tested. Patients with proven IgE-mediated allergy to cow's milk can utilize the above findings to predict suitable alternative sources of milk.

Khujneri, R. and M. M. Qureshi (1998). "Role of MRI in the diagnosis of cervical brucellar spondylitis: case report." <u>East Afr Med J</u> **75**(11): 671-672.

Magnetic resonance imaging (MRI) is the most suitable modality for evaluation of infectious spondylitis. It is more sensitive than other imaging modalities for detecting presence and extent of such infections. Though it is not always possible to differentiate various infections on the basis of imaging findings alone, there are certain features which along with a good clinical background, can differentiate brucellar spondylitis from other spinal infections. It is useful to follow up such patients after specific chemotherapy to further confirm the diagnosis.

Koning, N., et al. (2015). "Human Milk Blocks DC-SIGN-Pathogen Interaction via MUC1." <u>Front Immunol</u> **6**: 112.

Beneficial effects of breastfeeding are well-recognized and include both immediate neonatal protection against pathogens and long-term protection against allergies and autoimmune diseases. Although several proteins have been identified to have anti-viral or anti-bacterial effects like secretory IgA or lactoferrin, the mechanisms of immune modulation are not fully understood. Recent studies identified important beneficial effects of glycans in human milk, such as those expressed in oligosaccharides or on glycoproteins. Glycans are recognized by the carbohydrate receptors C-type lectins on dendritic cell (DC) and specific tissue macrophages, which exert important functions in immune modulation and immune homeostasis. A well-characterized C-type lectin is dendritic cell-specific intercellular adhesion molecule-3-grabbing non-integrin (DC-SIGN), which binds terminal fucose. The present study shows that in human milk, MUC1 is the major milk glycoprotein that binds to the lectin domain of DC-SIGN and prevents pathogen interaction through the presence of Lewis x-type oligosaccharides. Surprisingly, this was specific for human milk, as formula, bovine or camel milk did not show any presence of proteins that interacted with DC-SIGN. The expression of DC-SIGN is found in young infants along the entire gastrointestinal tract. Our data thus suggest the importance of human milk glycoproteins for blocking pathogen interaction to DC in young children. Moreover, a potential benefit of human milk later in life in shaping the infants immune system through DC-SIGN cannot be ruled out.

Korashy, H. M., et al. (2012). "Camel milk modulates the expression of aryl hydrocarbon receptor-regulated genes, Cyp1a1, Nqo1, and Gsta1, in murine hepatoma Hepa 1c1c7 cells." <u>J Biomed Biotechnol</u> **2012**: 782642.

There is a traditional belief in the Middle East that camel milk may aid in prevention and treatment of numerous cases of cancer yet, the exact mechanism was not investigated. Therefore, we examined the ability of camel milk to modulate the expression of a well-known cancer-activating gene, Cytochrome P450 1a1 (Cyp1a1), and cancer-protective genes, NAD(P)H:quinone oxidoreductase 1 (Nqo1) and glutathione S-transferase a1 (Gsta1), in murine hepatoma Hepa 1c1c7 cell line. Our results showed that camel milk significantly inhibited the induction of Cyp1a1 gene expression by 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most potent Cyp1a1 inducer and known carcinogenic chemical, at mRNA, protein, and activity levels in a concentration-dependent manner. In addition, camel milk significantly decreased the xenobiotic responsive element (XRE)-dependent luciferase activity, suggesting a transcriptional mechanism is involved. Furthermore, this inhibitory effect of camel milk was associated with a proportional increase in heme oxygenase 1. On the other hand, camel milk significantly induced Nqo1 and Gsta1 mRNA expression level in a concentration-dependent fashion. The RNA synthesis inhibitor, actinomycin D, completely blocked the induction of Nqo1 mRNA by camel milk

suggesting the requirement of de novo RNA synthesis through a transcriptional mechanism. In conclusion, camel milk modulates the expression of Cyp1a1, Nqo1, and Gsta1 at the transcriptional and posttranscriptional levels.

Korashy, H. M., et al. (2012). "Camel milk triggers apoptotic signaling pathways in human hepatoma HepG2 and breast cancer MCF7 cell lines through transcriptional mechanism." J Biomed Biotechnol **2012**: 593195.

Few published studies have reported the use of crude camel milk in the treatment of stomach infections, tuberculosis and cancer. Yet, little research was conducted on the effect of camel milk on the apoptosis and oxidative stress associated with human cancer. The present study investigated the effect and the underlying mechanisms of camel milk on the proliferation of human cancer cells using an in vitro model of human hepatoma (HepG2) and human breast (MCF7) cancer cells. Our results showed that camel milk, but not bovine milk, significantly inhibited HepG2 and MCF7 cells proliferation through the activation of caspase-3 mRNA and activity levels, and the induction of death receptors in both cell lines. In addition, Camel milk enhanced the expression of oxidative stress markers, heme oxygenase-1 and reactive oxygen species production in both cells. Mechanistically, the increase in caspase-3 mRNA levels by camel milk was completely blocked by the transcriptional inhibitor, actinomycin D; implying that camel milk increased de novo RNA synthesis. Furthermore, Inhibition of the mitogen activated protein kinases differentially modulated the camel milk-induced caspase-3 mRNA levels. Taken together, camel milk inhibited HepG2 and MCF7 cells survival and proliferation through the activation of both the extrinsic and intrinsic apoptotic pathways.

Korish, A. A. (2014). "The antidiabetic action of camel milk in experimental type 2 diabetes mellitus: an overview on the changes in incretin hormones, insulin resistance, and inflammatory cytokines." Horm Metab Res **46**(6): 404-411.

Folk medicine stories accredited the aptitude of camel milk (CMK) as a hypoglycemic agent and recent studies have confirmed this in the diabetic patients and experimental animals. However, the mechanism(s) by which CMK influences glucose homeostasis is yet unclear. The current study investigated the changes in the glucose homeostatic parameters, the incretin hormones, and the inflammatory cytokines in the CMK-treated diabetic animals. A model of type 2 diabetes mellitus was induced in rats by intraperitoneal injection of streptozotocin 40 mg/kg/day for 4 repeated doses. Camel milk treatment was administered for 8 weeks. The changes in glucagon like peptide-1 (GLP-1), glucose dependent insulinotropic peptide (GIP), glucose tolerance, fasting and glucose-stimulated insulin secretion, insulin resistance (IR), TNF-alpha, TGF-beta1, lipid profile, atherogenic index (AI), and body weight were investigated. The untreated diabetic animals showed hyperglycemia, increased HOMA-IR, hyperlipidemia, elevated AI, high serum incretins [GLP-1 and GIP], TNF-alpha, and TGF-beta1 levels and weight loss as compared with the control group. Camel milk treatment to the diabetic animals resulted in significant lowered fasting glucose level, hypolipidemia, decreased HOMA-IR, recovery of insulin secretion, weight gain, and no mortality during the study. Additionally, CMK inhibits the diabetes-induced elevation in incretin hormones, TNF-alpha and TGF-beta1 levels. The increase in glucose-stimulated insulin secretion, decreased HOMA-IR, modulation of the secretion and/or the action of incretins, and the anti-inflammatory effect are anticipated mechanisms to the antidiabetic effect of CMK and suggest it as a valuable adjuvant antidiabetic therapy.

Korish, A. A., et al. (2015). "Camel milk attenuates the biochemical and morphological features of diabetic nephropathy: inhibition of Smad1 and collagen type IV synthesis." Chem Biol Interact **229**: 100-108.

Diabetic nephropathy (DN) is a common microvascular complication of diabetes mellitus (DM) that worsens its morbidity and mortality. There is evidence that camel milk (CM) improves the glycemic control in DM but its effect on the renal complications especially the DN remains unclear. Thus the current study aimed to characterize the effects of CM treatment on streptozotocin (STZ)-induced DN. Using STZ-induced diabetes, we investigated the effect of CM treatment on kidney function, proteinuria, renal Smad1, collagen type IV (Col4), blood glucose, insulin resistance (IR), lipid peroxidation, the antioxidant superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH). In addition renal morphology was also examined. The current results showed that rats with untreated diabetes exhibited marked hyperglycemia, IR, high serum urea and creatinine levels, excessive proteinuria, increased renal Smad1 and Col4, glomerular expansion, and extracellular matrix deposition. There was also increased lipid peroxidation products, decreased antioxidant enzyme activity and GSH levels. Camel milk treatment decreased blood glucose, IR, and lipid peroxidation. Superoxide dismutase and CAT expression, CAT activity, and GSH levels were increased. The renoprotective effects of CM were demonstrated by the decreased serum urea and creatinine, proteinuria, Smad1, Col4, and preserved normal tubulo-glomerular morphology. In conclusion, beside its hypoglycemic action, CM attenuates the early changes of DN, decreased renal Smad1 and Col4. This could be attributed to a primary action on the glomerular mesangial cells, or secondarily to the hypoglycemic and antioxidant effects of CM. The protective effects of CM against DN support its use as an adjuvant anti-diabetes therapy.

Krupenko, S. S., et al. (1973). "[Lactotherapy for pox in camels]." Veterinariia **7**: 51-52.

Lee, G. H., et al. (2016). "Chronic Infection With Camelid Hepatitis E Virus in a Liver Transplant Recipient Who Regularly Consumes Camel Meat and Milk." Gastroenterology **150**(2): 355-357 e353.

There have been increasing reports of food-borne zoonotic transmission of hepatitis E virus (HEV) genotype 3, which causes chronic infections in immunosuppressed patients. We performed phylogenetic analyses of the HEV sequence (partial and full-length) from 1 patient from the Middle East who underwent liver transplantation, and compared it with other orthohepevirus A sequences. We found the patient to be infected by camelid HEV. This patient regularly consumed camel meat and milk, therefore camelid HEV, which is genotype 7, might infect human beings. Our finding links consumption of camel-derived food products to post-transplantation hepatitis E, which, if detected at early stages, can be cured with antiviral therapy and reduced administration of immunosuppressive agents.

Liao, Y., et al. (2010). "miR-214 regulates lactoferrin expression and pro-apoptotic function in mammary epithelial cells." J Nutr **140**(9): 1552-1556.

Lactoferrin (Lf) is an abundantly expressed protein in human milk. Lactoferrin exhibits several important biological functions, and its expression is regulated by multiple environmental factors. Cellular endogenous factors, however, have not been extensively studied with regard to lactoferrin gene expression. In this study, we showed that lactoferrin gene expression and function are directly targeted by miR-214 in HC11 and MCF7 cells. In the lactoferrin mRNA 3 prime untranslated region (UTR) of human, mouse, rat, pig, bovine, camel, and goat species, there is a conserved region that perfectly matches the seed region of miR-214. Transfection of miR-214 mimic in HEK293 cells dose-dependently

inhibited the activity of pGL3-control vector containing lactoferrin mRNA 3 prime UTR downstream of the luciferase gene. In HC11 cells, miR-214 overexpression inhibited the induction of lactoferrin expression by beta -estradiol (E2) and dexamethasone-prolactin-insulin (DPI). Furthermore, in MCF7 cells, overexpression of miR-214 markedly decreased lactoferrin expression (P lt 0.05), and inhibition of endogenous miR-214 expression increased lactoferrin expression and cellular apoptotic activities (P lt 0.05). In summary, our data showed that miR-214 is directly involved in lactoferrin expression and lactoferrin mediated cancer susceptibility (proapoptotic activities) in mammary epithelial cells.

Liao, Y., et al. (2012). "Inhibitory effects of native and recombinant full-length camel lactoferrin and its N and C lobes on hepatitis C virus infection of Huh7.5 cells." J Med Microbiol **61**(Pt 3): 375-383.

Lactoferrin has been suggested to have antiviral activity against hepatitis C virus (HCV). The objective of this study was to compare the effects of recombinant camel lactoferrin (rcLf), native camel lactoferrin (ncLf) and their N and C fragments on HCV infection in Huh7.5 cells. ncLf was purified from camel milk and N and C lobes were generated proteolytically. rcLf and its fragments were synthesized using a Bac-to-Bac baculovirus expression system. All proteins except the C lobe of rcLf were soluble. The inhibitory effects on HCV entry into Huh7.5 cells were evaluated by incubation of HCV with Lf prior to infection or pre-treatment of the cells with Lf prior to infection. The inhibitory effect on HCV amplification in Huh7.5 cells was determined by Lf treatment of HCV-infected cells. Nested RT-PCR was performed to amplify intracellular HCV 5' non-coding RNA sequences. rcLf and ncLf and their fragments could prevent HCV entry into Huh7.5 cells by direct interaction with the virus and inhibited virus amplification in Huh7.5 cells. Therefore, the N and C lobes of ncLf are sufficient to elicit anti-HCV effects in Huh7.5 cells. rcLf and its N lobe displayed similar HCV inhibitory effects to their native counterparts and may constitute an efficient and cost-effective approach for potential clinical applications.

Liu, Y., et al. (2016). "Rabies Outbreaks and Vaccination in Domestic Camels and Cattle in Northwest China." PLoS Negl Trop Dis **10**(9): e0004890.

In contrast to many countries where rabies has been well controlled in humans and livestock, even in wildlife, rabies is still endemic in almost regions of China. In Northwest China, rabies transmitted by stray dogs and wild foxes has caused heavy economic losses to local herdsmen, as well as causing numbers of human cases. In this study, as part of an investigation of ways to prevent rabies epidemics in livestock, we report an analysis of domestic cattle and camel rabies cases in Ningxia Hui (NHAR) and Inner Mongolia Autonomous Region (IMAR) and the immune efficacy of canine inactivated rabies vaccines in these animals. We found that rabies viruses from these animals are closely related to dog-hosted China I and fox-associated China III lineages, respectively, indicating that the infections originated from two different sources (dogs and wild foxes). As well as the previously reported Arctic and Arctic-related China IV lineage in IMAR, at least three separate phylogenetic groups of rabies virus consistently exist and spread throughout Northwest China. Since there is no licensed oral vaccine for wild foxes and no inactivated vaccine for large livestock, local canine inactivated vaccine products were used for emergency immunization of beef and milk cattle and bactrian (two-humped) camels in local farms. Compared with a single injection with one (low-efficacy) or three doses (high-cost), a single injection of a double dose of canine vaccine provided low-price and convenience for local veterinarians while inducing levels of virus neutralizing antibodies indicative of protection against rabies for at least 1 year in the cattle and camels. However, licensed vaccines for wildlife and large domestic animals are still needed in China.

Maghraby, A. S., et al. (2005). "Anti-schistosomal activity of colostral and mature camel milk on Schistosoma mansoni infected mice." Asia Pac J Clin Nutr **14**(4): 432-438.

The aim of the present study was to investigate the anti-schistosomal activity of colostral and mature camel milk on Schistosoma mansoni infected mice. Six weeks post infection, mean percentage of protection was detected through the hepatic portal vein. Glutathione-s-transferase (GST), alanine, aspartate transaminase (ALT and AST) and immunoglobulin G (IgG) levels were detected in sera of treated mice before and after infection. Antischistosomal activity of colostral and mature camel milk on Schistosoma mansoni infected mice were 12.81% and 31.60% respectively. The results showed that GST levels in sera of mice fed on colostral and mature camel milk were increased with mean values of 0.070, 0.108, 0.128 and 0.120 in colostral milk groups and 0. 072, 0.085, 0.166 and 0.20 in mature camel milk groups compared with the mice fed on basal diet with means values of 0.070, 0.085, 0.078 and 0.069 before infection and after two, four and six weeks of infection, respectively. On the other hand, there were slight differences on ALT and AST activities. Mice treated with colostral and mature milk (200 microl/day) showed an immunostimulatory effect by inducing IgG titers against soluble worm antigen preparation (SWAP) compared with control. Nevertheless, the difference was not considered significant (0.31 +/- 0.1) for colostrum (0.34 +/- 0.1) and for mature milk, as compared to normal control (0.2 +/- 0.04). Two, four and six weeks post infection, IgG level showed no significant change in sera from mice treated with colostral and mature milk as compared to control. In conclusion, colostral and mature camel milk showed an immuno-modualatory effect in normal healthy mice by inducing IgG and GST levels before and after infection with Schistosoma mansoni. Colostral and mature camel milk have a protective response against schistosomiasis.

Malik, A., et al. (2012). "A study of the anti-diabetic agents of camel milk." Int J Mol Med **30**(3): 585-592.

The number of people diagnosed with type 2 diabetes has risen steeply recently exhausting the ability of health care systems to deal with the epidemic. Seventy-five percent of people with diabetes live in low- and middle-income countries. The largest populations of diabetics are in China and India, with many of those people living in extreme poverty. Combined forces of governmental health care, charities and donation of pharmaceutical companies would not be able to cope with the financial demands needed for medicaments and treatments for these people. Therefore, it is worth looking into traditional folk remedies to find if there is any scientific merit to justify their claims for alleviating symptoms of diabetes. There is a traditional belief in the Middle East that regular consumption of camel milk helps in the prevention and control of diabetes. Recently, it has been reported that camel milk can have such properties. Literature review suggests the following possibilities: i) insulin in camel milk possesses special properties that makes absorption into circulation easier than insulin from other sources or cause resistance to proteolysis; ii) camel insulin is encapsulated in nanoparticles (lipid vesicles) that make possible its passage through the stomach and entry into the circulation; iii) some other elements of camel milk make it anti-diabetic. Sequence of camel insulin and its predicted digestion pattern do not suggest differentiability to overcome the mucosal barriers before been degraded and reaching the blood stream. However, we cannot exclude the possibility that insulin in camel milk is present in nanoparticles capable of transporting this hormone into the bloodstream. Although, much more probable is that camel milk contains 'insulin-like' small molecule substances that mimic insulin interaction with its receptor.

Manaer, T., et al. (2015). "Anti-diabetic effects of shubat in type 2 diabetic rats induced by combination of high-glucose-fat diet and low-dose streptozotocin." J Ethnopharmacol **169**: 269-274.

ETHNOPHARMACOLOGICAL RELEVANCE: Shubat, probiotic fermented camel milk, has been used both as a drink with ethnic flavor and a medicine among Kazakh population for diabetic patients. Kazakh people have lower diabetic prevalence and impaired fasting glucose (IFG) than do other ethnic groups living in Xinjiang China, which might be related to the beneficial properties of shubat. We therefore prepared shubat in laboratory and tested anti-diabetic activity and evaluated its possible hypolipidemic and renoprotective effects in type 2 diabetic rats. MATERIALS AND METHODS: Type 2 diabetic rats were induced by an administration of high-glucose-fat diet for 6 weeks and an intraperitoneal injection of streptozotocin (STZ, 30mg/kg). Diabetic rats were divided randomly into four groups and treated for 28 days with sitagliptin (30mg/kg) or shubat (6.97x10(6) lactic acid bacteria+2.20x10(4) yeasts) CFU/mL, (6.97x10(7) lactic acid bacteria+2.20x10(5) yeasts) CFU/mL and (6.97x10(8) lactic acid bacteria+2.20x10(6) yeasts) CFU/mL. In addition, a normal control group and a diabetic control group were used for comparison. All drugs were given orally once daily 10mL/kg for 4 weeks. Fasting blood glucose (FBG) and body weight (BW) were measured before treatment and every week thereafter. Total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c), serum creatinine (SCr), blood urea nitrogen (BUN), C-peptide, glycated hemoglobin (HbAlc), glucagon-like peptide-1 (GLP-1) levels and pancreas tissue sections were tested after 4 weeks. RESULTS: Shubat demonstrated positive hypoglycemic activity on FBG, HbAlc, C-peptide and GLP-1 levels, high dose shubat decreased FBG (P<0.01) and HbAlc (P<0.05), increased C-peptide (P<0.05) and GLP-1 (P<0.01), decreased serum TC, TG, LDL-c (P<0.05), increased HDL-c (P<0.01), and improved the reduction of body weight as well as decreased SCr and BUN levels (P<0.01) compared to diabetic controls. Histological analysis showed shubat protected the function of islets of type 2 diabetic rats. CONCLUSION: The results of this study indicate that shubat has significant hypoglycemic potential in T2D rats and may modulate lipid metabolism and protect renal function in the type 2 diabetic condition, which might be related to various probiotics acting through promoting the release of GLP-1 and improving the function of beta-cells.

Maswadeh, H. M., et al. (2015). "Etoposide incorporated into camel milk phospholipids liposomes shows increased activity against fibrosarcoma in a mouse model." Biomed Res Int **2015**: 743051.

Phospholipids were isolated from camel milk and identified by using high performance liquid chromatography and gas chromatography-mass spectrometry (GC/MS). Anticancer drug etoposide (ETP) was entrapped in liposomes, prepared from camel milk phospholipids, to determine its activity against fibrosarcoma in a murine model. Fibrosarcoma was induced in mice by injecting benzopyrene (BAP) and tumor-bearing mice were treated with various formulations of etoposide, including etoposide entrapped camel milk phospholipids liposomes (ETP-Cam-liposomes) and etoposide-loaded DPPC-liposomes (ETP-DPPC-liposomes). The tumor-bearing mice treated with ETP-Cam-liposomes showed slow progression of tumors and increased survival compared to free ETP or ETP-DPPC-liposomes. These results suggest that ETP-Cam-liposomes may prove to be a better drug delivery system for anticancer drugs.

Maswadeh, H. M., et al. (2015). "Coadministration of doxorubicin and etoposide loaded in camel milk phospholipids liposomes showed increased antitumor activity in a murine model." Int J Nanomedicine **10**: 2847-2855.

Small unilamellar vesicles from camel milk phospholipids (CML) mixture or from 1,2 dipalmitoyl-sn-glycero-3-phosphatidylcholine (DPPC) were prepared, and anticancer drugs doxorubicin (Dox) or etoposide (ETP) were loaded. Liposomal formulations were used against fibrosarcoma in a murine

model. Results showed a very high percentage of Dox encapsulation (~98%) in liposomes (Lip) prepared from CML-Lip or DPPC-Lip, whereas the percentage of encapsulations of ETP was on the lower side, 22% of CML-Lip and 18% for DPPC-Lip. Differential scanning calorimetry curves show that Dox enhances the lamellar formation in CML-Lip, whereas ETP enhances the nonlamellar formation. Differential scanning calorimetry curves also showed that the presence of Dox and ETP together into DPPC-Lip produced the interdigitation effect. The in vivo anticancer activity of liposomal formulations of Dox or ETP or a combination of both was assessed against benzopyrene (BAP)-induced fibrosarcoma in a murine model. Tumor-bearing mice treated with a combination of Dox and ETP loaded into CML-Lip showed increased survival and reduced tumor growth compared to other groups, including the combination of Dox and ETP in DPPC-Lip. Fibrosarcoma-bearing mice treated with a combination of free (Dox + ETP) showed much higher tumor growth compared to those groups treated with CML-Lip-(Dox + ETP) or DPPC-Lip-(Dox + ETP). Immunohistochemical study was also performed to show the expression of tumor-suppressor PTEN, and it was found that the tumor tissues from the group of mice treated with a combination of free (Dox + ETP) showed greater loss of cytoplasmic PTEN than tumor tissues obtained from the groups of mice treated with CML-Lip-(Dox + ETP) or DPPC-Lip-(Dox + ETP).

McKnight, R. A., et al. (1992). "The whey acidic protein." Cancer Treat Res **61**: 399-412.

Meena, S., et al. (2016). "Camel milk ameliorates hyperglycaemia and oxidative damage in type-1 diabetic experimental rats." J Dairy Res **83**(3): 412-419.

This study was designed to assess anti-diabetic potential of goat, camel, cow and buffalo milk in streptozotocin (STZ) induced type 1 diabetic albino wistar rats. A total of 48 rats were taken for the study where one group was kept as non-diabetic control group (8 rats) while others (40 rats) were made diabetic by STZ (50 mg/kg of body weight) injection. Among diabetic rats, a control group (8 rats) was kept and referred as diabetic control whereas other four groups (8 rats each) of diabetic rats were fed on 50 ml of goat or camel or cow or buffalo milk for 4 weeks. All the rats (non-diabetic and diabetic) were maintained on standard diet for four weeks. STZ administration resulted in enhancement of glucose, total cholesterol, triglyceride, low density lipoprotein, HbA1c and reduction in high density lipoprotein in plasma and lowering of antioxidative enzymes (catalase, glutathione peroxidase and superoxide dismutase) activities in pancreas, kidney, liver and RBCs, coupled with enhanced levels of TBARS and protein carbonyls in pancreas, kidney, liver and plasma. OGTT carried out at the end of 4 week milk feeding indicated that all milks helped in early maintenance of glucose level. All milks reduced atherogenic index. In camel milk fed diabetic group, insulin concentration enhanced to level noted for non-diabetic control while goat, cow and buffalo milk failed to restore insulin level. HbA1c level was also restored only in camel milk fed diabetic group. The level of antioxidative enzymes (catalase, GPx and SOD) in pancreas enhanced in all milk fed groups. Camel milk and to a reasonable extent goat milk reduced formation of TBARS and PCs in tissues and blood. It can be concluded that camel milk ameliorates hyperglycaemia and oxidative damage in type-1 diabetic experimental rats. Further, only camel milk completely ameliorated oxidative damage in pancreas and normalised insulin level.

Mihic, T., et al. (2016). "The Therapeutic Effects of Camel Milk: A Systematic Review of Animal and Human Trials." J Evid Based Complementary Altern Med **21**(4): NP110-126.

The clinical effectiveness and value of camel milk as a therapeutic agent is currently unclear. MEDLINE (1946 to March 2016), EMBASE (1974 to March 2016), and Google Scholar were searched

using the following terms: milk, bodily secretions, camels, camelus, camelini, camelidae, dromedary, bactrian camel, body fluid, and bodily secretions. Articles identified were reviewed if the study was investigating the use of camel milk for the potential treatment of diseases affecting humans. Of 430 studies, 24 were included after assessment. Identified studies highlighted treatment with camel milk of diseases, including diabetes, autism, cancer, various infections, heavy metal toxicity, colitis, and alcohol-induced toxicity. Although most studies using both the human and animal model do show a clinical benefit with an intervention and camel milk, limitations of these studies must be taken into consideration before widespread use. Based on the evidence, camel milk should not replace standard therapies for any indication in humans.

Mohamad, R. H., et al. (2009). "Camel milk as an adjuvant therapy for the treatment of type 1 diabetes: verification of a traditional ethnomedical practice." J Med Food **12**(2): 461-465.

There is a traditional belief in the Middle East that regular consumption of camel milk may aid in prevention and control of diabetes. The aim of this work was to evaluate the efficacy of camel milk as an adjuvant therapy in young type 1 diabetics. This 16-week randomized study enrolled 54 type 1 diabetic patients (average age 20 years) selected from those attending the outpatient diabetes clinic of the Menofia University Hospital, affiliated with Egypt's National Cancer Institute. Subjects were randomly divided into two groups of 27 patients: one received usual management (diet, exercise, and insulin), whereas the other received 500 mL of camel milk daily in addition to standard management. A control group of 10 healthy subjects was also assessed. The following parameters were evaluated at baseline and at 4 and 16 weeks: hemoglobin A1c (HbA1c), human C-peptide, lipid profile, serum insulin, anti-insulin antibodies, creatinine clearance, albumin in 24-hour urine, body mass index, and Diabetes Quality of Life score. The following parameters were significantly different between the usual-management group versus the camel milk group after 16 weeks: fasting blood sugar (227.2 +/- 17.7 vs. 98.9 +/- 16.2 mg/dL), HbA1c (9.59 +/- 2.05[%] vs. 7.16 +/- 1.84[%]), serum anti-insulin antibodies (26.20 +/- 7.69 vs. 20.92 +/- 5.45 microU/mL), urinary albumin excretion (25.17 +/- 5.43 vs. 14.54 +/- 5.62 mg/dL/24 hours), daily insulin dose (48.1 +/- 6.95 vs. 23 +/- 4.05 units), and body mass index (18.43 +/- 3.59 vs. 24.3 +/- 2.95 kg/m(2)). Most notably, C-peptide levels were markedly higher in the camel milk group (0.28 +/- 0.6 vs. 2.30 +/- 0.51 pmol/mL). These results suggest that, as an adjunct to standard management, daily ingestion of camel milk can aid metabolic control in young type 1 diabetics, at least in part by boosting endogenous insulin secretion.

Mohamed, W. A., et al. (2015). "Camel Milk: Potential Utility as an Adjunctive Therapy to Peg-IFN/RBV in HCV-4 Infected Patients in Egypt." Nutr Cancer **67**(8): 1305-1313.

The present prospective study aims to investigate the potential therapeutic effect and the underlying mechanisms of drinking camel milk for 60 days as an adjunctive therapy to the standard treatment PEG/RBV. Twenty-five hepatitis C virus (HCV)-infected Egyptian patients, with mild to moderate parenchymal affection to mild cirrhosis were enrolled in this study after proper history taking and clinical examination. Their biomarkers were evaluated before and after the addition of camel milk. The improving effect of camel milk was reflected on the marked inhibition of the serum levels of the proinflammatory markers, viz., tumor necrosis factor-alpha, monocyte chemotactic protein-1, hyaluronic acid, and TGF-beta1, besides PCR, AST, ALT, GGT, bilirubin, prothrombin time, INR, and alpha-fetoprotein. In addition, camel milk elevated significantly ($P < 0.001$) the serum levels of albumin, the antiapoptotic protein BCL-2, the total antioxidant capacity, interleukin-10, and vitamin D. In conclusion, our study revealed a regulatory function of camel milk on multiple parameters of inflammatory

mediators, immunomodulators, antiapoptosis, and antioxidants, giving insight into the potential therapeutic benefit underlying the anti-HCV actions of camel milk. The limitations of the current study include the small sample size recruited and the failure to test it on cohorts with severe stages of hepatitis; like Child-Pugh stage C, and hepatocellular carcinoma.

Mohammed, H. O., et al. (2015). "Risk of Escherichia coli O157:H7, Non-O157 Shiga Toxin-Producing Escherichia coli, and Campylobacter spp. in Food Animals and Their Products in Qatar." J Food Prot **78**(10): 1812-1818.

Escherichia coli O157:H7, non-O157 E. coli, and Campylobacter spp. are among the top-ranked pathogens that threaten the safety of food supply systems around the world. The associated risks and predisposing factors were investigated in a dynamic animal population using a repeat-cross-sectional study design. Animal and environmental samples were collected from dairy and camel farms, chicken processing plants, and abattoirs and analyzed for the presence of these pathogens using a combination of bacterial enrichment and real-time PCR tests without culture confirmation. Data on putative risk factors were also collected and analyzed. E. coli O157:H7 was detected by PCR at higher levels in sheep and camel feces than in cattle feces (odds ratios [OR], 6.8 and 21.1, respectively). Although the genes indicating E. coli O157:H7 were detected at a relatively higher rate (4.3%) in fecal samples from dairy cattle, they were less common in milk and udder swabs from the same animals (1 and 2%, respectively). Among the food adulterants, E. coli O103 was more common in cattle fecal samples, whereas O26 was more common in sheep feces and O45 in camel feces compared with cattle (OR, 2.6 and 3.1, respectively). The occurrence of E. coli in the targeted populations differed by the type of sample and season of the year. Campylobacter jejuni and Campylobacter coli were more common in sheep and camel feces than in cattle feces. Most of the survey and surveillance of E. coli focused on serogroup O157 as a potential foodborne hazard; however, based on the PCR results, non-O157 Shiga toxin-producing E. coli serotypes appeared to be more common, and efforts should be made to include them in food safety programs.

Mohanty, D. P., et al. (2016). "Milk derived bioactive peptides and their impact on human health - A review." Saudi J Biol Sci **23**(5): 577-583.

Milk-derived bioactive peptides have been identified as potential ingredients of health-promoting functional foods. These bioactive peptides are targeted at diet-related chronic diseases especially the non-communicable diseases viz., obesity, cardiovascular diseases and diabetes. Peptides derived from the milk of cow, goat, sheep, buffalo and camel exert multifunctional properties, including anti-microbial, immune modulatory, anti-oxidant, inhibitory effect on enzymes, anti-thrombotic, and antagonistic activities against various toxic agents. Majority of those regulate immunological, gastrointestinal, hormonal and neurological responses, thereby playing a vital role in the prevention of cancer, osteoporosis, hypertension and other disorders as discussed in this review. For the commercial production of such novel bioactive peptides large scale technologies based on membrane separation and ion exchange chromatography methods have been developed. Separation and identification of those peptides and their pharmacodynamic parameters are necessary to transfer their potent functional properties into food applications. The present review summarizes the preliminary classes of bioactive milk-derived peptides along with their physiological functions, general characteristics and potential applications in health-care.

Monecke, S., et al. (2011). "Microarray-based genotyping of Staphylococcus aureus isolates from camels." Vet Microbiol **150**(3-4): 309-314.

Staphylococcus aureus is a common cause of mastitis and other diseases in camels. In order to obtain data on population structure as well as on the carriage of toxin genes and resistance markers, a collection of 45 isolates from dromedaries of Dubai, United Arab Emirates, were genotyped. These isolates belonged to clonal complexes CC6 (twenty isolates; 44.44%), CC30 (sixteen isolates; 35.56%), CC188 (five isolates; 11.11%), CC152 (1 isolate, 2.2%) and to a previously un-described sequence type (ST1755: arcc-18, aroe-115, glpf-6, gmk-2 pta-109, tpi-50 and yqil-2; three isolates; 6.67%). Resistance genes proved to be rare. Only three out of 45 isolates (6.67%) carried the beta-lactamase operon. The tetracycline resistance gene tetK was also detected in three isolates (6.67%). Neither the mecA gene, defining MRSA, nor other resistance genes were found. Common virulence markers included leukocidin genes lukD+lukE (in twenty-five isolates; 55.56%), the staphylokinase gene sak (twenty-two isolates; 48.89%), the enterotoxin gene cluster egc (fifteen isolates; 33.33%), and a distinct variant of the enterotoxin A gene (sea-320E, GenBank AY196686.1; thirteen isolates; 28.89%). One CC152 isolate was positive for genes encoding the Panton-Valentine leukocidin (lukF-PV+lukS-PV). This study provides first genotyping data on the population structure and the presence of toxin genes and resistance markers of S. aureus strains in Middle Eastern camels.

Murray, M. J., et al. (1980). "An ecological interdependence of diet and disease? A study of infection in one tribe consuming two different diets." Am J Clin Nutr **33**(3): 697-701.

The nature and incidence of infections were studied in two groups of Turkana living in the same area but eating different diets; one consumed milk only and the other a combination of fish and milk. The only apparent and significant nutritional difference between the two groups was mild iron deficiency in the milk drinkers. Episodes of fever, symptomatic infection with malaria and brucellosis, molluscum contagiosum and common warts, episodes of diarrhea, and serological evidence of infection with Entamoeba histolytica were significantly increased in Turkana eating fish. We suggest that this phenomenon may result from a disruption of a long-standing ecological compromise between the all-milk diet of the Turkana and the pathogenic organisms.

Musa, M. T., et al. (2008). "Brucellosis in camels (Camelus dromedarius) in Darfur, Western Sudan." J Comp Pathol **138**(2-3): 151-155.

In a field outbreak of brucellosis in 21 camels mixed with cattle, sheep and goats, five camels, three of which showed clinical signs, were serologically positive. In a subsequent abattoir survey of apparently healthy camels, six animals were seropositive, albeit with titres that tended to be lower than those found in the field outbreak. Of the six seropositive slaughtered camels, five were shown to have lymph nodes (prescapular and supramammary) infected with brucellae (Brucella melitensis biovar 3, two camels; Brucella abortus biovar 6, three camels). Infection of camels with B. abortus biovar 6 had not previously been reported. Infection of the supramammary lymph nodes presents a potential hazard to those who consume raw camels' milk, a common practice in nomadic camel owners.

Omrani, A. S., et al. (2015). "Middle East respiratory syndrome coronavirus (MERS-CoV): animal to human interaction." Pathog Glob Health **109**(8): 354-362.

The Middle East respiratory syndrome coronavirus (MERS-CoV) is a novel enzootic betacoronavirus that was first described in September 2012. The clinical spectrum of MERS-CoV infection in humans ranges from an asymptomatic or mild respiratory illness to severe pneumonia and multi-organ failure; overall mortality is around 35.7%. Bats harbour several betacoronaviruses that are closely related to MERS-CoV but more research is needed to establish the relationship between bats and MERS-CoV. The seroprevalence of MERS-CoV antibodies is very high in dromedary camels in Eastern Africa and the Arabian Peninsula. MERS-CoV RNA and viable virus have been isolated from dromedary camels, including some with respiratory symptoms. Furthermore, near-identical strains of MERS-CoV have been isolated from epidemiologically linked humans and camels, confirming inter-transmission, most probably from camels to humans. Though inter-human spread within health care settings is responsible for the majority of reported MERS-CoV cases, the virus is incapable at present of causing sustained human-to-human transmission. Clusters can be readily controlled with implementation of appropriate infection control procedures. Phylogenetic and sequencing data strongly suggest that MERS-CoV originated from bat ancestors after undergoing a recombination event in the spike protein, possibly in dromedary camels in Africa, before its exportation to the Arabian Peninsula along the camel trading routes. MERS-CoV serosurveys are needed to investigate possible unrecognized human infections in Africa. Amongst the important measures to control MERS-CoV spread are strict regulation of camel movement, regular herd screening and isolation of infected camels, use of personal protective equipment by camel handlers and enforcing rules banning all consumption of unpasteurized camel milk and urine.

Osman, K. M., et al. (2014). "Confirmed low prevalence of Listeria mastitis in she-camel milk delivers a safe, alternative milk for human consumption." Acta Trop **130**: 1-6.

She-camel milk is an alternative solution for people allergic to milk; unfortunately, potential harmful bacteria have not been tested in she-camel milk. Listeria monocytogenes is one harmful bacterium that causes adverse health effects if chronically or acutely ingested by humans. The purpose of this study was to estimate the prevalence, characterize the phenotypic, genetic characterization, virulence factors, and antibiopotential harmful bacteria resistance profile of Listeria isolated from the milk of she-camel. Udder milk samples were collected from 100 she-camels and screened for mastitis using the California mastitis test (46 healthy female camels, 24 subclinical mastitic animals and 30 clinical mastitic animals). Samples were then examined for the presence of pathogenic Listeria spp; if located, the isolation of Listeria was completed using the International Organization for Standards technique to test for pathogenicity. The isolates were subjected to PCR assay for virulence-associated genes. Listeria spp. were isolated from 4% of samples and only 1.0% was confirmed as L. monocytogenes. The results of this study provide evidence for the low prevalence of intramammary Listeria infection; additionally, this study concludes she-camel milk in healthy camels milked and harvested in proper hygienic conditions may be used as alternative milk for human consumption.

Osoro, E. M., et al. (2015). "Strong Association Between Human and Animal Brucella Seropositivity in a Linked Study in Kenya, 2012-2013." Am J Trop Med Hyg **93**(2): 224-231.

Brucellosis is a common bacterial zoonotic infection but data on the prevalence among humans and animals is limited in Kenya. A cross-sectional survey was conducted in three counties practicing different livestock production systems to simultaneously assess the seroprevalence of, and risk factors for brucellosis among humans and their livestock (cattle, sheep, camels, and goats). A two-stage cluster sampling method with random selection of sublocations and households was conducted. Blood samples

were collected from humans and animals and tested for Brucella immunoglobulin G (IgG) antibodies. Human and animal individual seroprevalence was 16% and 8%, respectively. Household and herd seroprevalence ranged from 5% to 73% and 6% to 68%, respectively. There was a 6-fold odds of human seropositivity in households with a seropositive animal compared with those without. Risk factors for human seropositivity included regular ingestion of raw milk (adjusted odds ratio [aOR] = 3.5, 95% confidence interval [CI] = 2.8-4.4), exposure to goats (herding, milking, and feeding) (aOR = 3.1, 95% CI = 2.5-3.8), and handling of animal hides (aOR = 1.8, 95% CI = 1.5-2.2). Attaining at least high school education and above was a protective factor for human seropositivity (aOR = 0.3, 95% CI = 0.3-0.4). This linked study provides evidence of a strong association between human and animal seropositivity at the household level.

Radwan, A. I., et al. (1995). "Control of Brucella melitensis infection in a large camel herd in Saudi Arabia using antibiotherapy and vaccination with Rev. 1 vaccine." Rev Sci Tech **14**(3): 719-732.

The authors describe an attempt to control Brucella melitensis infection in a large camel herd in Saudi Arabia. Sera from the entire herd (2,536) were examined by the Rose Bengal and standard United States of America buffered plate agglutination tests. The overall Brucella seroprevalence was 8%. Milk samples from the 120 seropositive milking camels were cultured on Brucella-selective media. B. melitensis biovars 1, 2 and 3 were isolated from 41 camels (34%). Seropositive camels (202) were treated for the first time with a combination of long-acting oxytetracycline (OTC) at a dose of 25 mg/kg administered intramuscularly (i.m.) every 2 days for 30 days and streptomycin at 25 mg/kg i.m. every 2 days for 16 days. In addition, milking camels were given OTC-intramammary infusion at a rate of 10 ml/teat every 2 days for 8 days. This regimen was found to be effective in eliminating the shedding of Brucella organisms by camels, with no relapse. Moreover, all treated camels became seronegative within 16 months after treatment. Seronegative camels (2,331) were vaccinated for the first time with the B. melitensis Rev. 1 strain vaccine, as follows: a) 175 young camels (aged three months to one year) were each inoculated subcutaneously with a full dose (1-2 x 10(9) viable organisms in 1 ml). Brucella antibody titres between 1:50 and 1:200 were detected 2-4 weeks post-vaccination. Brucella antibodies decreased gradually until the animals became seronegative 8 months after vaccination. b) 2,156 camels aged more than one year were each inoculated subcutaneously with a reduced dose (1-2 x 10(6) viable organisms in 1 ml). Antibody titres measured 2-4 weeks post-vaccination varied from 1:25 to 1:200. The titres decreased gradually, until the animals became seronegative 3 months post-vaccination. No Brucella organisms were recovered from repeated udder secretion samples from all vaccinated milking camels, and no abortions were recorded among pregnant vaccinated camels.

Radwan, A. I., et al. (1992). "Serological and bacteriological study of brucellosis in camels in central Saudi Arabia." Rev Sci Tech **11**(3): 837-844.

Sera from 2,630 apparently normal adult camels (Camelus dromedarius) raised in central Saudi Arabia (Riyadh and Al-Kharj cities) were examined serologically by the Rose Bengal and standard United States of America Brucella plate agglutination tests. The overall seroprevalence of brucellosis in the restricted populations of tested camels was 8%. The seroprevalence of brucellosis among camels raised in small numbers in the backyards of 24 houses in Riyadh and those intensively raised on one large camel farm near Al-Kharj were 4.3% and 8.6% respectively. Fresh milk samples from 100 brucellosis seropositive camels from Riyadh and Al-Kharj were cultured on Brucella-selective media. Brucella melitensis biovars 1 and 2 were isolated and identified from 26 camels. Epidemiologically, brucellosis in

camels in central Saudi Arabia appeared to be connected with B. melitensis infection of sheep and goats, and also represents a serious public health risk.

Rahbarizadeh, F., et al. (2005). "The production and characterization of novel heavy-chain antibodies against the tandem repeat region of MUC1 mucin." Immunol Invest **34**(4): 431-452.

Camelidae are known to produce immunoglobulins (Igs) devoid of light chains and constant heavy-chain domains (CH1). Antigen-specific fragments of these heavy-chain IgGs (VHH) are of great interest in biotechnology applications. This paper describes the first example of successfully raised heavy-chain antibodies in Camelus dromedarius (single-humped camel) and Camelus bactrianus (two-humped camel) against a MUC1 related peptide that is found to be an important epitope expressed in cancerous tissue. Camels were immunized against a synthetic peptide corresponding to the tandem repeat region of MUC1 mucin and cancerous tissue preparation obtained from patients suffering from breast carcinoma. Three IgG subclasses with different binding properties to protein A and G were purified by affinity chromatography. Both conventional and heavy-chain IgG antibodies were produced in response to MUC1-related peptide. The elicited antibodies could react specifically with the tandem repeat region of MUC1 mucin in an enzyme linked immunosorbant assay (ELISA). Anti-peptide antibodies were purified after passing antiserum over two affinity chromatography columns. Using ELISA, immunocytochemistry and Western blotting, the interaction of purified antibodies with different antigens was evaluated. The antibodies were observed to be selectively bound to antigens namely: MUC1 peptide (tandem repeat region), human milk fat globule membrane (HMFG), deglycosylated human milk fat globule membrane (D-HMFG), homogenized cancerous breast tissue and a native MUC1 purified from ascitic fluid. Ka values of specific polyclonal antipeptide antibodies were estimated in C. dromedarius and C. bactrianus, as 7 x 10(10) M(-1) and 1.4 x 10(10) M(-1) respectively.

Rahbarizadeh, F., et al. (2004). "Production of novel recombinant single-domain antibodies against tandem repeat region of MUC1 mucin." Hybrid Hybridomics **23**(3): 151-159.

Recently, the existence of "heavy-chain" antibody in Camelidae has been described. However, as yet there is no data on the binding of this type of antibody to peptides. In addition, there was not any report of production of single-domain antibodies in two-humped camels (Camelus bactrianus). In the present study, these questions are addressed. We showed the feasibility of immunizing old world camels, cloning the repertoire of the variable domain of their heavy-chain antibodies, panning and selection, leading to the successful identification of minimum-sized antigen binders. Antigen-specific fragments of the heavy-chain IgGs (V(HH)) are of great interest in biotechnology because they are very stable, highly soluble, and react specifically and with high affinity to the antigens. In this study, we immunized two camels (Camelus dromedarius and Camelus bactrianus) with homogenized cancerous tissues, synthetic peptide, and human milk fat globule membrane (HMFG), and generated two V(HH) libraries displayed on phage particles. Some single-domain antibody fragments have been isolated that specifically recognize the tandem repeat region of MUC1. The camels' single-domain V(HH) harbor the original, intact antigen binding site and reacted specifically and with high affinity to the tandem repeat region of MUC1. Indeed soluble, specific antigen binders and good affinities (in the range of 0.2 x 10(9) M(-1) to 0.6 x 10(9) M(-1)) were identified from these libraries. This is the first example of the isolation of camel anti-peptide V(HH) domains.

Rahimi, E., et al. (2011). "Prevalence of Coxiella burnetii in bulk milk samples from dairy bovine, ovine, caprine, and camel herds in Iran as determined by polymerase chain reaction." <u>Foodborne Pathog Dis</u> **8**(2): 307-310.

Q fever is a widespread zoonosis caused by the obligate intracellular micro-organism Coxiella burnetii. The objective of this study was to determine the prevalence rate of C. burnetii in bulk milk samples from dairy bovine, ovine, caprine, and camel herds in Isfahan province, Iran. In the present study, 567 bulk milk samples from 186 dairy bovine, ovine, caprine, and camel herds were tested for C. burnetii using a nested polymerase chain reaction assay. The animals whose milk samples collected for this study were clinically healthy. In total, 8 of 247 (3.2%) bovine milk samples were positive; the positive samples originated from 6 of 90 (6.7%) dairy herds. Eight of 140 (5.7%) ovine bulk milk samples from 42 sheep breeding farms and 5 of 110 (4.5%) caprine bulk milk samples from 32 goat breeding farms were positive for C. burnetii. One of 70 (1.4%) camel bulk milk samples from 22 camel breeding farms was also positive for C. burnetii. Although no extensive prevalence study was undertaken, the results of this study indicate that clinically healthy dairy animals are important sources of C. burnetii infection in Iran. To the authors' knowledge, this study is the first report of direct identification of C. burnetii using polymerase chain reaction in bulk milk samples from dairy ovine herds in Iran and the first report of direct identification of C. burnetii in bulk milk samples from dairy camel herds. Further intensive prevalence studies on Coxiella infection and on possible risks of dairy products will be needed to elucidate the epidemiology of Q fever in Iran.

Rahimi, E. and E. K. Kheirabadi (2012). "Detection of Helicobacter pylori in bovine, buffalo, camel, ovine, and caprine milk in Iran." <u>Foodborne Pathog Dis</u> **9**(5): 453-456.

Helicobacter pylori infection in humans is one of the most common infections worldwide. However, the origin and transmission of this bacterium has not been clearly explained. One of the suggested theories is transmission via raw milk from animals to human beings. This study was conducted to determine the prevalence rate of H. pylori in bulk milk samples from dairy bovine, buffalo, camel, ovine, and caprine herds in Iran. In the present study, 447 bulk milk samples from 230 dairy bovine, buffalo, camel, ovine, and caprine herds were collected in four provinces and tested for H. pylori by cultural method and polymerase chain reaction (PCR) for the detection of the ureC (glmM) gene. The animals whose milk samples collected for this study were clinically healthy. Using the cultural method, three of 447 milk samples (0.67%), including two sheep (2.2%) and one buffalo (1.6%) milk samples, were found to be contaminated with H. pylori. H. pylori ureC gene was detected in 56 (12.5%) of milk samples, including 19 cow (14.1%), 11 sheep (12.2%), nine goat (8.7%), two camel (3.6%), and 15 buffalo (23.4%) milk samples. Using PCR method, there were significant differences (p<0.05) in the level of contamination with H. pylori between milk samples collected from different species. The present study is the first report of the isolation of H. pylori from raw sheep and buffalo milk in Iran and the first demonstration of H. pylori DNA in camel and buffalo milk.

Ramadan, R. O., et al. (1987). "Chronic obstructive mastitis in the camel. A clinicopathological study." <u>Cornell Vet</u> **77**(2): 132-150.

Unilateral chronic mastitis in three she camels was due to obstruction of the teat canal by keratin. This lead to dilatation of the ducts, retention of milk and secondary bacterial infection. The teat canals and dilated ducts were lined by stratified squamous epithelium. There was excessive periductal fibrosis. Pasteurella hemolytica was isolated from one animal and Staphylococcus aureus from another.

The fluid from the third animal was sterile. The condition was treated successfully by surgical amputation of the affected halves of the udder.

Redwan el, R. M. and A. Tabll (2007). "Camel lactoferrin markedly inhibits hepatitis C virus genotype 4 infection of human peripheral blood leukocytes." J Immunoassay Immunochem **28**(3): 267-277.

Hepatitis C virus (HCV) is a serious worldwide health risk and, to date, no effective treatments to prevent progression to chronic infection have been discovered. To combat the disease, Egyptian patients often use traditional medicines, for instance, camel milk, which contains lactoferrin. Currently, lactoferrin is one of the primary biopharmaceutical drug candidates against HCV infection. Camel lactoferrin (cLf) purification and biochemical and immunological characterization have shown its similarity to human and bovine lactoferrin, and crossreacts with the anti-human lactoferrin antibody. Incubation of human leukocytes with cLf then infected with HCV did not prevent the HCV entry into the cells, while the direct interaction between the HCV and cLf leads to a complete virus entry inhibition after seven days incubation. Our results suggest that the cLf may be one of the camel milk components having antiviral activity. In conclusion, we have demonstrated the potential for cLf to inhibit HCV entry into human leukocytes with more efficiency than human or bovine lactoferrin.

Redwan, E. M., et al. (2014). "Screening the anti infectivity potentials of native N- and C-lobes derived from the camel lactoferrin against hepatitis C virus." BMC Complement Altern Med **14**: 219.

BACKGROUND: Hepatitis C virus (HCV) infection represents a worldwide health threat that still needs efficient protective vaccine and/or effective drug. The traditional medicine, such as camel milk, is heavily used by the large sector of HCV patients to control the infection due to the high cost of the available standard therapy. Camel milk contains lactoferrin, which plays an important and multifunctional role in innate immunity and specific host defense against microbial infection. Continuing the analysis of the effectiveness of camel lactoferrin against HCV, the current study aimed to separate and purify the native N- and C-lobes from the proteolytically cleaved camel lactoferrin (cLF) and to compare their in vitro activities against the HCV infection in Huh7.5 cells in order to determine the most active domain. METHODS: Lactoferrin and its digested N- and C-lobes were purified by Mono S 5/50 GL column and Superdex 200 5/150 column. The purified proteins were assessed through three venues: 1. To inhibit intracellular replication, HCV infected cells were treated with the proteins at different concentrations and time intervals; 2. The proteins were directly incubated with the viral particles (neutralization) and then such neutralized viruses were used to infect cells; 3. The cells were protected with proteins before exposure to the virus. The antiviral potentials of the cLf and its lobes were determined using three techniques: 1. RT-nested PCR, 2. Real-time PCR, and 3. Flow cytometry. RESULTS: N- and C-lobes were purified in two consecutive steps; using Mono-S and Superdex 200 columns. The molecular mass of N- and C-lobes was about 40 kDa. cLF and its lobes could prevent HCV entry into Huh 7.5 cells with activity reached 100% through direct interaction with the virus. The inhibition of intracellular viral replication by N-lobe is 2-fold and 3-fold more effective than that of the cLF and C-lobe, respectively. CONCLUSION: Generated native N- and C-lobes from camel lactoferrin demonstrated a range of noticeably different potentials against HCV cellular infectivity. The anti-HCV activities were sorted as N-lobe > cLf > C-lobe.

Regassa, A., et al. (2013). "Prevalence, risk factors, and major bacterial causes of camel mastitis in Borana Zone, Oromia Regional State, Ethiopia." Trop Anim Health Prod **45**(7): 1589-1595.

A cross-sectional study was carried out from November 2010 up to April 2011 to estimate mastitis prevalence and associated risk factors and to assess its bacterial causes in traditionally managed camels in Borana Zone, Southern Ethiopia. Thus, 348 lactating camels were examined clinically, and subclinical cases were checked with California mastitis test (CMT). The overall prevalence of mastitis was 44.8 % (156/348), comprising clinical (19, 5.4 %) and subclinical (137, 39.4 %) cases. The quarter level prevalence of mastitis was 24.0 % (334/1,392). Of the total 1,392 examined teats, 30 were blind, and hence, from the 1,362 non-blind CMT-examined teats, 22.3 % (304/1,362) were CMT positive. Of the 304 CMT-positive samples, 264 were culture positive (197 Gram-positive, 41 Gram-negative, and 26 mixed isolates), and 40 were culture negative. The prevalence of Staphylococcus aureus was found to be the highest at both the animal (12.8 %, 39/304) and quarter level (2.9 %, 39/1,362). Regression analysis revealed higher likelihood of mastitis occurrence among camels from Dharito (OR = 3.4, 95 % confidence interval (CI) = 1.8, 6.4), Gagna (OR = 3.4, 95 % CI = 1.8, 6.5), and Haro Bake (OR = 2.6, 95 % CI = 1.3, 5.1) than camels from Surupha. Likewise, there was higher chance of mastitis occurrence among camels at the early lactation stage (OR = 2.3, 95 % CI = 1.1, 4.6) and camels with udder/teat lesions (OR = 13.7, 95 % CI = 1.7, 109.4) than among camels at late lactation stage and camels with healthy udder/teats, respectively. In conclusion, this study reveals the current status of camel mastitis in Southern Ethiopia.

Restani, P., et al. (2002). "Cross-reactivity between mammalian proteins." <u>Ann Allergy Asthma Immunol</u> **89**(6 Suppl 1): 11-15.

BACKGROUND: Cross-reactivity between food allergens occurs when they share part of their amino acid sequence, or when their three-dimensional molecular structure causes them to have a similar capacity to bind specific antibodies. OBJECTIVES: To review data from our laboratory on cross-reactivity between mammalian proteins (milk and meat allergens). METHODS: Studies used immunoelectrophoresis (sodium dodecyl sulfate-polyacrylamide gel electrophoresis/polyacrylamide gel electrophoresis and immunoblotting), and animal monoclonal antibodies. RESULTS: The findings suggest that animal monoclonal antibodies specific for cow's milk proteins are able to recognize the major part of milk proteins from mammals bred in Mediterranean countries (sheep, goat, and buffalo); weak cross-reactivity was observed with milk proteins from mares and donkeys. None of the antibodies used in our studies reacted with proteins from an exotic mammalian species: the camel. Similar cross-reactions were found with human circulating immunoglobulin E from children allergic to milk. With regard to beef allergy, monoclonal antibodies specific for bovine serum albumin cross-reacted only with ovine serum albumin, whereas the number of sera from allergic children able to recognize other mammalian serum albumins depended directly on the closeness of phylogenetic relationship between animal species and inversely on the percent identity with human serum albumin in the main epitopic sequence. CONCLUSION: An area of heterogeneity between animal and human species in a critical amino acid sequence (epitope) of an allergen can determine the degree of immunogenic activity.

Restani, P., et al. (1999). "Cross-reactivity between milk proteins from different animal species." <u>Clin Exp Allergy</u> **29**(7): 997-1004.

BACKGROUND: Cow's milk allergy is quite frequent in the first years of human life. When breast-feeding is not possible, a cow's milk substitute must be provided for allergic subjects. Different alternatives to cow's milk have been suggested as protein sources (soy, hydrolysed proteins, goat's milk, etc.), but all these dietetic solutions are not without risks for polyallergic or more sensitive subjects. OBJECTIVE: To obtain new information on the suitability of other mammalian milks for allergic children, we evaluated the cross-reactivity between milk proteins from different animal species. METHODS: Milk

samples were analysed by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE). To detect antibody-antigen complexes, immunoblotting was performed by using sera from children allergic to cow's and ewe's milk (RAST class >/= 4) and monoclonal antibodies (MoAb) specific for bovine proteins (caseins and beta-lactoglobulin). RESULTS: IgEs from children allergic to cow's milk are capable of recognizing most part of milk proteins from mammals bred in European countries (ewe, goat, buffalo), while no serum used in this study contains IgEs reacting with camel's milk proteins. Camel's milk was also not recognized from circulating IgEs from a child specifically allergic to ewe's milk. Specific antibovine monoclonal antibodies cross-reacted with proteins from other mammalian species, apart from those of camel. CONCLUSIONS: Homologies in amino acidic composition could justify the cross-reactivity observed between proteins from different animal species. On the other hand, the phylogenetic difference could be responsible for the failed recognition of camel's proteins by circulating IgEs and monoclonal antibodies.

Rhodes, H. M., et al. (2016). "Invasive human brucellosis infection in travelers to and immigrants from the Horn of Africa related to the consumption of raw camel milk." Travel Med Infect Dis **14**(3): 255-260.

BACKGROUND: Brucellosis is the commonest zoonosis worldwide and typically results from ingestion of unpasteurized goat and sheep milk and cheese. Consumption of camel milk is common in the Middle East and the Horn of Africa, but is an infrequently reported source of brucellosis. METHODS: We report three immigrant patients seen in one hospital system between 2007 and 2013 with brucellosis due to the consumption of camel milk. RESULTS: The case patients presented after 3-14 days of symptoms following travel to countries where Brucella is endemic. All three patients were bacteremic. One patient had definite infective endocarditis, one had possible endocarditis and one patient presented with acute brucellosis. The diagnoses were made expeditiously and appropriate treatment initiated. CONCLUSIONS: Knowledge of travel, local customs and immigration patterns are keys to early Brucella diagnosis and optimal treatment. Previous reports implicating camel milk as the source of Brucella infection have been limited to patients living in or traveling to and from the Middle East. This report highlights the acquisition of Brucella infection in travelers to and immigrants from the Horn of Africa related to the consumption of camel milk.

Romli, F., et al. (2016). "The Growth Inhibitory Potential and Antimetastatic Effect of Camel Urine on Breast Cancer Cells In Vitro and In Vivo." Integr Cancer Ther.

Although it may sound unpleasant, camel urine has been consumed extensively for years in the Middle East as it is believed to be able to treat a wide range of diseases such as fever, cold, or even cancer. People usually take it by mixing small drops with camel milk or take it directly. The project aims to study the effects of camel urine in inhibiting the growth potential and metastatic ability of 4T1 cancer cell line in vitro and in vivo. Based on the MTT result, the cytotoxicity of camel urine against 4T1 cell was established, and it was dose-dependent. Additionally, the antimetastatic potential of camel urine was tested by running several assays such as scratch assay, migration and invasion assay, and mouse aortic ring assay with promising results in the ability of camel urine to inhibit metastatic process of the 4T1 cells. In order to fully establish camel urine's potential, an in vivo study was carried out by treating mice inoculated with 4T1 cells with 2 different doses of camel urine. By the end of the treatment period, the tumor in both treated groups had reduced in size as compared to the control group. Additional assays such as the TUNEL assay, immunophenotyping, cytokine level detection assay, clonogenic assay, and proteome profiler demonstrated the capability of camel urine to reduce and inhibit the metastatic potential of 4T1 cells in vivo. To sum up, further study of anticancer properties of camel urine is justified,

as evidenced through the in vitro and in vivo studies carried out. Better results were obtained at higher concentration of camel urine used in vivo. Apart from that, this project has laid out the mechanisms employed by the substance to inhibit the growth and the metastatic process of the 4T1 cell.

Saeidi, E. and A. Sheikhshahrokh (2016). "vacA Genotype Status of Helicobacter pylori Isolated from Foods with Animal Origin." <u>Biomed Res Int</u> **2016**: 8701067.

According to controversial theories and results of studies, foods with animal origins play an important role in the transmission of H. pylori to human. The aim of this study was to determine the distribution of vacA genotypes of H. pylori, isolated from milk and meat samples of cow, sheep, goat, camel, and buffalo. Eight hundred and twenty raw milk and meat samples were collected from various parts of Iran. Samples were cultured and those found positive for H. pylori were analyzed for the presence of various genotypes of vacA gene. Out of 420 milk and 400 meat samples, 92 (21.90%) and 105 (26.25%) were positive for H. pylori, respectively. The most commonly detected genotypes in the vacA gene were s1a (86.80%), m1a (79.18%), s1b (69.54%), and m1b (63.45%) and detected combined genotypes were mostly m1as1a (68.52%), m1as1b (60.40%), m1bs1b (55.83%), and m1bs1a (53.29%). High presence of bacteria in the milk and meat samples of sheep represents that sheep may be the natural host of H. pylori. High presence of H. pylori strains in milk and meat samples similar to vacA genotypes in human being suggests that milk and meat samples could be the sources of bacteria for human.

Sahoo, B. R., et al. (2014). "Exploration of the binding modes of buffalo PGRP1 receptor complexed with meso-diaminopimelic acid and lysine-type peptidoglycans by molecular dynamics simulation and free energy calculation." <u>Chem Biol Interact</u> **220**: 255-268.

The peptidoglycan recognition proteins (PGRPs) are the key components of innate-immunity, and are highly specific for the recognition of bacterial peptidoglycans (PGN). Among different mammalian PGRPs, the PGRP1 binds to murein PGN of Gram-positive bacteria (lysine-type) and also have bactericidal activity towards Gram-negative bacteria (diaminopimelic acid or Dap-type). Buffaloes are the major sources of milk and meat in Asian sub-continents and are highly exposed to bacterial infections. The PGRP activates the innate-immune signaling, but their studies has been confined to limited species due to lack of structural and functional information. So, to understand the structural constituents, 3D model of buffalo PGRP1 (bfPGRP1) was constructed and conformational and dynamics properties of bfPGRP1 was studied. The bfPGRP1 model highly resembled human and camel PGRP structure, and shared a highly flexible N-terminus and centrally placed L-shaped cleft. Docking simulation of muramyl-tripeptide, tetrapeptide, pentapeptide-Dap-(MTP-Dap, MTrP-Dap and MPP-Dap) and lysine-type (MTP-Lys, MTrP-Lys and MPP-Lys) in AutoDock 4.2 and ArgusLab 4.0.1 anticipated beta1, alpha2, alpha4, beta4, and loops connecting beta1-alpha2, alpha2-beta2, beta3-beta4 and alpha4-alpha5 as the key interacting domains. The bfPGRP1-ligand complex molecular dynamics simulation followed by free binding energy (BE) computation conceded BE values of -18.30, -35.53, -41.80, -25.03, -24.62 and -22.30 kJ mol(-1) for MTP-Dap, MTrP-Dap, MPP-Dap, MTP-Lys, MTrP-Lys and MPP-Lys, respectively. The groove-surface and key binding residues involved in PGN-Dap and Lys-type interaction intended by the molecular docking, and were also accompanied by significant BE values directed their importance in pharmacogenomics, and warrants further in vivo studies for drug targeting and immune signaling pathways exploration.

Salah, A. A., et al. (2015). "Estimating the economic impact of Trypanosoma evansi infection on production of camel herds in Somaliland." Trop Anim Health Prod **47**(4): 707-714.

The traditional livestock sector in Somalia is based on nomadic pastoralism where sheep, goats and camels are herded in large numbers. Data from 1609 females (27 % lactating) and 550 males (26 % exported) belonging to 40 pastoralists were analysed in this study. The expected amount of revenue the herders could lose per year in the studied area was estimated at US$404,630 being made up of US$314,630 from decreased milk yield and US$90,000 from reduced market value of exported animals. However, all the camels in Somaliland are at risk of acquiring surra infection, and therefore extrapolating the current findings to the total population could potentially lose US$223,164,000. This highlights the loss in the magnitude of US$164,253,600 from decreased milk yield and US$58,910,400 from body condition loss. Overall, the benefit in controlling Trypanosoma evansi infection in the study area was US$398,880 (n = 2159). On average, US$720 was saved per head per year from improved milk production in treated animals and US$615 from the increased value of exported camels. It is concluded that all three-treatment options evaluated were economically beneficial strategies; however, the biannual treatment of seropositive camels in the herds was the best financial option.

Salwa, M. Q. and A. F. Lina (2010). "Antigenotoxic and anticytotoxic effect of camel milk in mice treated with cisplatin." Saudi J Biol Sci **17**(2): 159-166.

Camel milk (CM) has good nutritive value, in addition to its antigenotoxic and anticytotoxic effects. Therefore the aim of this investigation was to evaluate the capacity of CM to inhibit the micronucleated polychromatic erythrocytes (MnPCEs) in the bone marrow and improve the mitotic activity produced by cisplatin. Cisplatin is one of the most widely used antineoplastic drugs in the treatment of cancer. The 70 adult male Swiss albino mice were divided into seven groups:Gr. I: treated with distilled water and considered as a control group.Gr. II: treated with camel milk (33 ml/kg, b.w).Gr. III: treated previously with cisplatin (0.5 mg/kg, b.w).Gr. IV: treated with camel milk and followed after 2 h. with cisplatin (33 ml/kg --> 0.5 mg/kg, b.w).Gr. V: treated with camel milk and cisplatin at the same time (33 ml/kg + 0.5 mg/kg, b.w).Gr. VI: treated with an acute single dose of cisplatin (2.5 mg/kg, b.w).Gr. VII: treated with camel milk prior and followed with an acute single dose of cisplatin (33 ml/kg --> 2.5 mg /kg, b.w). The animals were sacrificed 24 h after cisplatin injection. The pretreatment with CM dose caused a significant decrease (P < 0.001) in the frequency of MnPCEs and increase (P < 0.001) in the mitotic index (MI) induced by cisplatin when compared with the groups treated with cisplatin alone. The possible explanation for the antigenotoxic and anticytotoxic effects observed in the pretreatment with CM is ascribed to its contents. In conclusion, from the findings we suggest that this milk has some antioxidant effect, and the antigenotoxic mechanism of this milk needs to be explored further before their use during cisplatin chemotherapy.

Sboui, A., et al. (2010). "Anti-diabetic effect of camel milk in alloxan-induced diabetic dogs: a dose-response experiment." J Anim Physiol Anim Nutr (Berl) **94**(4): 540-546.

This study was conducted to evaluate the effect of camel milk in alloxan-induced diabetic dogs and to follow this effect at three doses of milk. Firstly, three groups of dogs were used: two groups composed each of four diabetic dogs and receiving raw camel milk (treatment 1) or cow milk (treatment 2), and four healthy dogs getting raw camel milk (treatment 3) were used as control. Each animal was treated with 500 ml of milk daily. Secondly, we compared the effects of three amounts of camel milk: 100 ml, 250 ml and 500 ml to treat the diabetic dogs. After week 3, the dogs treated with camel milk showed a statistically significant decrease in blood glucose (from 10.88 +/- 0.55 to 6.22 +/- 0.5 mmol/l)

and total protein concentrations (from 78.16 +/- 2.61 g/l to 63.63 +/- 4.43 g/l). For cholesterol levels, there was a decrease from week 2 (from 6.17 +/- 0.5 mmol/l to 4.79 +/- 0.5 mmol/l). There were no significant difference in blood glucose, cholesterol or total protein concentrations in dogs drinking 250 and 500 ml of camel milk. The dogs treated with 100 ml of camel milk did not show any significant decrease in blood glucose levels, and cholesterol and total protein concentrations. The investigation was not limited to the improvement in glycemic balance, lipids and proteins control in diabetic dogs getting camel milk, but we also noted a stability of this state after the dogs stopped to drink milk. This effect depended on the quantity of camel milk used to treat diabetic dogs.

Schelling, E., et al. (2005). "Morbidity and nutrition patterns of three nomadic pastoralist communities of Chad." Acta Trop **95**(1): 16-25.

As a part of an interdisciplinary research and action programme, morbidity and nutritional patterns were assessed in three nomadic communities: Fulani and Arab cattle breeders and Arab camel breeders, of two prefectures in Chad. The predominant morbidity pattern of Chadian nomadic pastoralists (representing approximately 10% of the total population of the country) had not been documented so far. A total of 1092 women, men and children was examined by a physician and interviewed during two surveys in the dry season and one in the wet season (1999--2000). Participants with no complaint were rare. Pulmonary disorders (e.g. bronchitis) were most often diagnosed for children under 5 years of age. Of the adult participants, 4.6% were suspected of tuberculosis. Febrile diarrhoea occurred more often during the wet season when access to clean drinking water was precarious. Malaria was only rarely clinically diagnosed among Arabs during the dry season, whereas Fulani, who stayed in the vicinity of Lake Chad, were also affected during this period. A 24-h dietary recall showed that less Arab women than men consumed milk during the dry season (66% versus 92%). Malnutrition was only documented for 3 out of 328 children (0--14 years). Arab women in childbearing age had a higher proportion of children not surviving when compared to Fulani women (0.2 versus 0.07). This study identified several implications for reseach and interventions in nomadic settings. Innovative and integrated health services for nomads can possibly be extended to many settings as nomadic pastoralists have in common a similar way of life driven by the needs of their animals.

Schulze zur Wiesch, J., et al. (2010). "Genomic tandem repeat analysis proves laboratory-acquired brucellosis in veterinary (camel) diagnostic laboratory in the United Arab Emirates." Zoonoses Public Health **57**(5): 315-317.

We report a case of a 64-year-old veterinarian working in a state camel veterinary laboratory who was diagnosed with and treated for acute brucellosis with complicating epididymo-orchitis. Genomic tandem repeat analysis (MLVA-16) revealed identical Brucella strains in patient cultures and from different dromedary milk samples positive for Brucella melitensis, thereby confirming the diagnosis of a laboratory acquired infection. The case illustrates the high (airborne) infectivity of brucellosis in laboratory settings and the need to implement vigorous bio-safety measures in veterinary laboratories handling camel specimen diagnostic veterinary laboratory.

Schuster, R. K., et al. (2016). "Scarabaeus cristatus (Coleoptera: Scarabaeidae) as intermediate host of Physocephalus dromedarii (Nematoda: Spirocercidae)--a contribution to the epidemiology of camel physocephalidosis." Parasitol Res **115**(3): 1161-1166.

In UAE, camel Physocephalus dromedarii was diagnosed for the first time in 2011 in dromedaries from a farm that previously had imported animals from foreign countries. The large scarab beetle, Scarabaeus cristatus, was found to be the major intermediate host for this parasite in Dubai. A total of 638 specimens of S. cristatus were collected and examined for the presence of third-stage larvae of nematode larvae at two sites in the Dubai Emirate (Emirates Industry for Camel Milk and Products and horse endurance training track) within a distance of 15 km. Third-stage larvae of P. dromedarii were detected in 94 and 97 % of beetles collected from the territory of the camel milk farm and the endurance training track, respectively. In addition to third-stage larvae, 264 beetles contained second-stage larvae. Only four beetles were infected with other than P. dromedarii larvae. The average larval burden in beetles from camel milk farm was significantly higher compared to those in beetles collected from the other site (1538 vs. 697). Comparison of larval burdens in juvenile and adult beetles collected at the camel milk farm showed a significantly higher intensity in adult specimens (501 vs. 1734) while in beetles found on the horse endurance track, larval burdens were comparable (548 vs. 858). The results suggest that S. cristatus become infected at the camel milk farm, and in search for other sources of food, they fly to places where they were found feeding on feces of other animals.

Shaalan, M. A., et al. (2002). "Brucellosis in children: clinical observations in 115 cases." Int J Infect Dis **6**(3): 182-186.

OBJECTIVE: Brucellosis is endemic in Saudi Arabia. This report summarizes the epidemiology of brucellosis in children. METHOD: A retrospective review was made of medical records of all patients admitted to King Fahad National Guard Hospital with brucellosis during the period from 1984 to 1995. RESULTS: Children < or =12 years constituted 115/545 (21%) of the total brucellosis admissions. The mean age was 5.8 years and 64% of the patients were males. Consumption of unpasteurized milk (often from camel) was the main source of infection. In 70% the clinical picture was dominated by arthritis, 20% of patients presented with a non-specific febrile illness without localizing signs, and 10% had a febrile illness with uncommon presentations. Brucella serology was most helpful in making an early diagnosis. Initial titers of >1:640 were found in 90% of the cases. Bacteremia was observed in 45% and of the isolates speciated, 96% were Brucella melitensis. No increase in resistance to commonly used antimicrobials was noted during the 12-year study period. A combination of rifampin plus co-trimoxazole with or without streptomycin was used in two thirds of the patients. The overall rate of relapse was 9% and one patient died from neurobrucellosis. CONCLUSION: Brucellosis presents in various ways and should be included in the differential diagnosis of arthritis in endemic countries. Prevention should rely on education including on boiling raw milk.

Shimol, S. B., et al. (2012). "Human brucellosis outbreak acquired through camel milk ingestion in southern Israel." Isr Med Assoc J **14**(8): 475-478.

BACKGROUND: Human brucellosis is common in southern Israel among the semi-nomadic Bedouin, a population that consumes unpasteurized dairy products. Though camel milk ingestion is a known mechanism for brucellosis acquisition, only a few reports of sporadic cases have been published in the medical literature. OBJECTIVES: To describe a local brucellosis outbreak in 15 extended Bedouin family members, following ingestion of infected camel milk. METHODS: Data regarding patient's clinical manifestations, laboratory findings, treatment and outcome were collected from the hospital and the health fund clinics' computerized database. Camel's blood and milk were tested for Brucella serology and culture. Cases were defined by positive Rose Bengal test, symptoms correlating with brucellosis, and consumption of infected camel milk. RESULTS: Fifteen patients were diagnosed with acute brucellosis

from March to June 2011. Sixty percent of cases had serum agglutination test titers of 1:160 or higher and 4/8 (50%) had positive blood culture for Brucella melitensis. Arthralgia and fever were the most consistent clinical manifestations. Blood and milk serology and milk culture taken from the female camel were positive for Brucella melitensis. CONCLUSIONS: The treating physicians must consider the possibility of infected camel milk ingestion as the mode of infection, both in sporadic cases and in outbreaks of brucellosis.

Shuiep, E. S., et al. (2009). "Phenotypic and genotypic characterization of Staphylococcus aureus isolated from raw camel milk samples." Res Vet Sci **86**(2): 211-215.

    In the present study 320 milk samples collected from 160 apparently healthy camels of three different locations in Sudan were investigated for the presence of Staphylococcus aureus resulting in the isolation of this bacterial pathogen from 28 milk samples from 24 camels. Twenty-five S. aureus were identified phenotypically and by PCR mediated amplification of species-specific genes or gene segments. Investigation of the S. aureus for toxinogenic potential revealed that three S. aureus strains were positive for the enterotoxin encoding gene sec and the genes seg, sei, sem, sen and seo, representing the egc gene cluster. In addition all 25 S. aureus were positive for the superantigen-like encoding gene ssl7 (set1). Partial sequencing of gene sec of the three S. aureus strains yielded an almost complete sequence identity to the sequence of the sec variant sec2. However, all three sec2 genes of the present study showed a deletion of one base causing a frame shift and a corresponding earlier stop codon. According to the present results, the raw camel milk collected from three locations in Sudan seems to be, at least at this stage, of minor importance as vector causing staphylococcal food poisoning.

Soliman, M. M., et al. (2015). "Protective effects of camel milk against pathogenicity induced by Escherichia coli and Staphylococcus aureus in Wistar rats." Mol Med Rep **12**(6): 8306-8312.

    The aim of the present study was to investigate the protective effects of camel milk on hepatic pathogenicity induced by experimental infection with Escherichia (E. coli) and Staphylococcus aureus (S. aureus) in Wistar rats. The rats were divided into six groups: The control and camel milk groups received water and camel milk, respectively; two groups received camel milk for 2 weeks prior to intraperitoneal injection of either E. coli or S. aureus; and two groups were injected intraperitoneally with E. coli and S. aureus, respectively. All animals were maintained under observation for 7 days prior to biochemical and gene expression analyses. The rats treated with camel milk alone exhibited no changes in expression levels of glutamicpyruvate transaminase (GPT) or glutamicoxaloacetic transaminase (GOT), compared with the watertreated group. The E. coli and S. aureusinjected rats exhibited a significant increase in oxidative stress, and prior treatment with camel milk normalized the observed changes in the expression levels of GPT, GOT and malondialdehyde (MDA). Treatment with camel milk decreased the total bacterial count in liver tissue samples obtained from the rats injected with E. coli and S. aureus. Camel milk administration increased the expression levels of glutathioneStransferase and superoxide dismutase, which were downregulated following E. coli and S. aureus injection. In addition, camel milk downregulated the increased expression of interleukin6 and apoptosisassociated genes. Of note, administration of camel milk alone increased the expression levels of the B cell lymphoma 2associated X protein and survivin antiapoptotic genes, and supplementation prior to the injection of E. coli and S. aureus induced further upregulation, In conclusion, camel milk exerted protective effects against E. coli and S. aureus pathogenicity, by modulating the extent of lipid peroxidation, together with the antioxidant defense system, immune cytokines, apoptosis and the expression of anti-apoptotic genes in the liver of Wistar rats.

Sprague, L. D., et al. (2012). "A review on camel brucellosis: a zoonosis sustained by ignorance and indifference." Pathog Glob Health **106**(3): 144-149.

In many developing countries of Asia and Africa, camels are one of the most important sources of income for the nomadic population. With increasing urbanization, camel milk and meat have gained a wider market and commercialization and consumption of camel products are on the rise. Camel brucellosis can be encountered in all camel rearing countries with exception of Australia. High animal and herd prevalences have been reported from numerous countries, which not only pose a continuous risk for human infection, but also increase the spread of infection through uncontrolled trade of clinically inconspicuous animals. This short review aims at providing an overview on diagnostic investigations, as well as the public health and economic impact of brucellosis in old world camels.

van Doremalen, N., et al. (2014). "Stability of Middle East respiratory syndrome coronavirus in milk." Emerg Infect Dis **20**(7): 1263-1264.

Wang, M., et al. (2013). "Toxoplasma gondii infection in Bactrian camel (Camelus bactrianus) in China." Vet Parasitol **192**(1-3): 288-289.

Camel is important to the economy of many countries. We report Toxoplasma gondii infection in Bactrian camels (Camelus bactrianus), first for this host. Antibodies to T. gondii were found in sera of 7 of 234 C. bactrianus from Qinghai Province, northwestern China. Sera were tested by a commercial indirect hemagglutination test at a cut-off of 1:64. Age or the gender of the camel did not significantly affect the seroprevalence. Results are of public health and economic importance because camel milk and meat are used for human consumption in many countries, including China.

Yagil, R. (2013). "Camel milk and its unique anti-diarrheal properties." Isr Med Assoc J **15**(1): 35-36.

Younan, M., et al. (2001). "Application of the California mastitis test in intramammary Streptococcus agalactiae and Staphylococcus aureus infections of camels (Camelus dromedarius) in Kenya." Prev Vet Med **51**(3-4): 307-316.

A study was conducted on 207 lactating camels in six herds in Kenya to evaluate the California mastitis test (CMT) for the detection of intramammary infections (IMIs) caused by Streptococcus agalactiae and Staphylococcus aureus and to investigate the prevalence of both the pathogens in the camel udder. IMI with S. agalactiae was found in 12% of all camels sampled. IMI with S. aureus was present in 11% of all camels sampled. The herd-level prevalence of IMI varied between 0 and 50% for S. agalactiae and between 0 and 13% for S. aureus. Longitudinal observations over 10-12 months confirmed persistent infections for both pathogens. Observations in one herd suggested that camel pox was a contributing factor in spreading and exacerbating S. agalactiae udder infections.The CMT had quarter-level sensitivities of 77 and 68% for S. agalactiae and S. aureus in camels, respectively. The CMT specificities were 91% for both the pathogens.

Younan, M., et al. (2005). "Identification and molecular characterization of Streptococcus equi subsp. zooepidemicus isolated from camels (Camelus dromedarius) and camel milk in Kenya and Somalia." J Vet Med B Infect Dis Vet Public Health **52**(3): 142-146.

Seventeen Streptococcus equi subsp. zooepidemicus strains isolated from camels and camel milk in Kenya and Somalia were identified by their cultural characteristics, by biochemical and serological reactions with the help of commercial identification systems and by molecular studies using a multiplex PCR. The isolates were further characterized by a PCR-mediated detection of size polymorphisms in the 16S-23S rDNA intergenic spacer region and the virulence gene szp and by amplification of the virulence gene cne. These molecular analysis are potentially useful in identifying and characterizing S. equi subsp. zooepidemicus strains of this origin and could possibly be valuable in epidemiological investigations.

Yousefi, M., et al. (2016). "Epidemiological and clinical characteristics of patients with Middle East Respiratory syndrome Coronavirus in Iran in 2014." Jpn J Infect Dis.

The Middle East Respiratory Syndrome Coronavirus (MERS-CoV) was a great global concern in 2014. It has a wide range of manifestations that may differ in each area and also high mortality. In this study, we reported epidemiological characteristics, history, clinical and Paraclinical information of all five patients with laboratory-confirmed MERS-CoV from Iran. All these patients were from Kerman province. None of them had a history of travel, contact with animals or consumption of camel milk products but all of them had some sort of contact with a person who had been in Saudi-Arabia and experienced respiratory infection. One of the five patients was male and two of them passed away from the disease. Fever and respiratory symptoms were the most common symptoms and two patients had watery diarrhea. There were alveolar pattern in all available CXR's and elevated liver aminotransferases in three patients. Two of them had leucopenia and none of them had renal failure. In conclusion, we insist that all patients with acute respiratory symptoms, who had contact with a person that had recently traveled to Saudi-Arabia and experienced respiratory infection, should be investigated for MERS-CoV.

Zibaee, S., et al. (2015). "Nutritional and Therapeutic Characteristics of Camel Milk in Children: A Systematic Review." Electron Physician **7**(7): 1523-1528.

INTRODUCTION: Camel milk is the closest to a human mother's milk. Camel milk is different from other milks, however, having low sugar and cholesterol, high minerals (sodium, potassium, iron, copper, zinc and magnesium, and vitamin C). The milk is considered have medicinal characteristics as well. This systematic review is aimed at determining and reporting nutritional values and medicinal characteristics of camel milk in children. METHODS: The search strategy of the current review is "(camel AND milk) AND (autism OR food allergy OR milk allergy OR children OR diarrhea." The search was conducted via PubMed, Scopus, and Google scholar. Also two Persian scientific databases (SID and Iranmedex) and international congresses were investigated. Full-text papers and abstracts on the topic of camel milk, evaluating nutritional value and medicinal properties, were included in this systematic review. RESULTS: Out of the 472 records found in the resources, 35 related studies were included in the final analysis. The result showed that camel milk is highly nutritious and is safe for consumption by children. CONCLUSION: It seems that many researchers did not follow a specific guideline for reporting and confirming the therapeutic properties of camel milk in children, but there is evidence denoting the importance, trials, and investigations of its usability and benefits. Camel milk as a supplemental treatment seems less invasive and costly than specialist care, medications, alternative treatments, and

behavioral interventions. Based on our findings, camel milk is safer for children, effective in the treatment of autism, improves general well-being, promotes body natural defenses, is a good nutritional source, and can helps the daily nutritional needs of humans.

Zinger-Yosovich, K. D., et al. (2010). "Blocking of Pseudomonas aeruginosa and Chromobacterium violaceum lectins by diverse mammalian milks." J Dairy Sci **93**(2): 473-482.

Pseudomonas aeruginosa and Chromobacterium violaceum morbid and mortal infections are initiated by bacterial adherence to host-cell receptors via their adhesins, including lectins (which also contribute to bacterial biofilm formation). Pseudomonas aeruginosa produces a galactophilic lectin, PA-IL (LecA), and a fucophilic (Lewis-specific) lectin, PA-IIL (LecB), and C. violaceum produces a fucophilic (H-specific) lectin, CV-IIL. The antibiotic resistance of these bacteria prompted the search for glycosylated receptor-mimicking compounds that would function as glycodecoys for blocking lectin attachment to human cell receptors. Lectins PA-IL and PA-IIL have been shown to be useful for such glycodecoy probing, clearly differentiating between human and cow milks. This article describes their usage, together with CV-IIL and the plant lectin concanavalin A, for comparing the anti-lectin-dependent adhesion potential of diverse mammalian milks. The results show that the diverse milks differ in blocking (hemagglutination inhibition) and differential binding (Western blots) of these lectins. Human milk most strongly inhibited the 3 bacterial lectins (with PA-IIL superiority), followed by alpaca, giraffe, and monkey milks, whereas cow milk was a weak inhibitor. Lectin PA-IL was inhibited strongly by human, followed by alpaca, mare, giraffe, buffalo, and monkey milks, weakly by camel milk, and not at all by rabbit milk. Lectins PA-IIL and CV-IIL were also most sensitive to human milk, followed by alpaca, monkey, giraffe, rabbit, and camel milks but negligibly sensitive to buffalo and mare milks. Plant lectin concanavalinA, which was used as the reference, differed from them in that it was much less sensitive to human milk and was equally as sensitive to cow milk. These results have provided important information on the anti-lectin-dependent adhesion potential of the diverse milks examined. They showed that human followed by alpaca, giraffe, and Rhesus monkey milks efficiently blocked the binding of both the galactophilic and fucophilic (>mannophilic) pathogen lectins. The results also proved the advantage of isolated pathogenic bacterial lectins as superb probes for unveiling bacterial adhesion-blocking glycodecoys. The chosen milks or their polymeric glycans might be implicated in blocking lectin-dependent adhesion of antibiotic-resistant pathogens leading to skin, eye, ear, and gastrointestinal infections.

Wentz, I. Benefits of Camel Milk in Hashimoto's Hypothyroidism, January 2, 2017