

*Short Communication*

# CAMEL MILK- AN ADVANTAGE TO HUMAN HEALTH AND PROSPECTS OF CAMEL MILK DAIRY AT NETHERLANDS

M.G. Smits

European Camel Research Society, Johanniterlaan 7, 6721 XX Bennekom, The Netherlands

Increase of knowledge about the health of camel products will stimulate the sale of these products through its increased production (FAO, 2006). The camel product should get approval of the European Food and Safety Authority, EFSA (ASP and Bryngelsson, 2008).

Camel dairy Smits ([www.camelmilk.nl](http://www.camelmilk.nl)) is, as far as now, the sole European camel farm permitted to milk camels. In 2014, the farm had about 85 camels. They are milked with a milking machine, 4 camels at the same time. Milk is sold fresh from the farm. Frozen untreated fresh camel milk is sold all over Europe and camel milk powder is available all over the world (see web shop at [www.camelmilk.nl](http://www.camelmilk.nl)). Because of a possible relation between Middle east Respiratory syndrome (MERS) and dromedaries (Reusken *et al*, 2013), livestock and milk was investigated for the presence of MERS antibodies and was found to be free of them.

The ammonia emission of camels is about 10% of that of cows (Smits and Monteny, 2009). Nowadays camels can be well accommodated and milked according to the strict European governmental rules.

Several products with camel milk (powder) have been developed, including camel milk capsules, camel milk chocolates, liqueur and camel milk bread. Together with the HAS University of Applied Sciences, Hertogenbosch, In Netherlands, new products are being developed including camel ice, camel pancake mix and camel bread mix.

## Methods

Databases Pubmed and Embase were searched for studies of camel milk using the words camel milk, diabetes, cow's milk allergy. Furthermore, European researchers of camel products were also interviewed.

## Results

### Diabetes

Agrawal *et al* (2004, 2005c) highlighted the significance of camel milk for patients with diabetes. Camel milk was found to improve glucose metabolism. Studies in diabetic dogs showed that the effect continued after stopping drinking camel milk (Sboui *et al*, 2010). It was opined that diabetes hardly occurs in a community where camel milk is part of a daily diet as compared to the communities where camel milk was not consumed (Agrawal *et al*, 2007a).

Several controlled studies have been performed in diabetic patients. They showed in patients with Diabetes Type I that camel milk improved glucose concentrations and HbA1c and these cases required less exogenous insulin (Agrawal *et al*, 2002; Agrawal *et al*, 2003; Agrawal *et al*, 2004; Agrawal *et al*, 2005a; Agrawal *et al*, 2005b; Agrawal *et al*, 2007b; Agrawal *et al*, 2011a). This finding was confirmed in an Egyptian study (Mohamad *et al*, 2009). Researchers demonstrated that camel milk may help not only diabetes type I patients, but also Diabetes Type II patients (Agrawal *et al*, 2011b).

In a unpublished study with Dutch camel milk performed at the department of Nutrition of Wageningen University and Research (WUR) showed that intake of 500 ml of fresh camel milk once, lowered blood glucose in diabetic type I patients more than cow's milk. In another unpublished study performed at WUR the glycaemic index of camel milk was found lower than that of cow's milk while the glycaemic index of fresh camel milk did not differ from that of frozen camel milk and camel milk powder (<http://clinicaltrials.gov/ct2/results?term=camel&Search=search>).

The positive influence of camel milk at the glucose metabolism of diabetic Type I patients (who

---

SEND REPRINT REQUEST TO M.G. SMITS [email: marcel@globemail.nl](mailto:marcel@globemail.nl)

do not produce insulin) was initially described to insulin-like properties of camel milk proteins (Agrawal *et al*, 2005a). Cow's milk insulin-like proteins are destroyed by acid in the stomach especially as milk forms a coagulum in the stomach, allowing acid and pepsin to break down proteins over a period of time. But camel milk lacks coagulum formation and passes rapidly through the stomach, together with the insulin-like proteins (Wernery *et al*, 2006). Camel milk contains about 52 units insulin/litre (Zagorski *et al*, 1998). Furthermore, immunomodulating properties of camel milk proteins may be involved in the prevention and treatment of diabetes (Dahlquist, 1999; De *et al*, 2011; El Agamy and Nawar 2000; Korish, 2014).

Korish (2014) showed that camel milk probably also improves the impaired glucose metabolism by its anti-inflammatory and hypolipidemic effects. He studied the effects of camel milk in rats with induced diabetes type II. In diabetes type II tissue receptors are less sensitive for insulin resulting in high blood glucose levels and decreased insulin. In the animal diabetes type II model camel milk restored the diabetes type II associated overproduction of the proximal small intestinal incretins glucagon-like peptide-1 and glucose dependent insulinotropic peptide. In this aspect camel milk resembles the action of the new class of incretin-based glucose-lowering drugs for the treatment of diabetes type II, including exenatide and liraglutide (Chu *et al*, 2008; Nauck *et al*, 1993).

### ***Cow's milk protein allergy***

Human milk and camel milk do not contain beta-globulin, which is present in the milk cow, goat and horse and is the main cause of cow's milk allergy (Nodake *et al*, 2010). Because of its lack of beta-globulin and immunomodulating properties (El Agamy, 2007), camel milk can help patients with cow's milk allergy according to the world allergy organisation (Fiocch, 2010).

Camel milk can be tolerated by children with severe cow's milk protein allergy (Ehlayel *et al*, 2011; Shabo *et al*, 2005). Another study suggested that camel milk can also be tolerated by people with lactose intolerance (Cardoso *et al*, 2010).

Presently a study is going on at the Jeroen Bosch Hospital in Hertogenbosch, The Netherlands to study the effects of camel milk in adults and children aged > 3 yrs with cow's milk allergy. (<http://www.clinicaltrials.gov/ct2/results?term=camel&Search=Search>). Composition, constituents and proprieter of

Dutch amel milk are well described previously (Smits *et al*, 2011).

Increase of evidence that camel milk indeed has health improving proteins will make it easier to get financial support for other clinical studies with camel milk, i.e. in patients with chronic gastro-intestinal disorders (Yagil, 2013), psoriasis (Shimshoni, 2014) and autism (Al-Ayadhi and Elamin, 2013; Bashir and Al-Ayadhi, 2014; Wernery *et al*, 2012).

### **References**

- Agrawal RP, Beniwal R, Kochar DK and Kothari RP (2002). Effect of camel milk on glycemic control, risk factors and diabetes quality of life in type-1 diabetes: A randomised prospective controlled study. *International Journal of Diabetes in Developing Countries* (2):70-74.
- Agrawal RP, Swami SC and Beniwal R (2003). Effect of camel milk on glycemic control, lipid profile and diabetes quality of life in type 1 diabetes: a randomised prospective controlled cross over study. *Indian Journal of Animal Sciences* (73):1105-1110.
- Agrawal RP, KocharDK,, Sahan MS, Tuteja FC and Ghorui SK (2004). Hypoglycemic activity of camel milk streptozotocin induced diabetic rats. *International Journal of Diabetes in Developing Countries* (24):47-49.
- Agrawal RP, Beniwal R, Kochar DK, Tuteja FC, Ghorui SK, Sahani MS and Sharma S (2005a). 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 randomised controlled trial. *Diabetes Research and Clinical Practice* (68):176-177.
- Agrawal RP, Beniwal R and Sharma S (2005b). Effect of raw camel milk in type 1 diabetic patients: 1 year randomised study. *Journal of Camel Practice and Research* (12):27-31.
- Agrawa RP, Sahani MS, Tuteja FC, Ghouri SK, Sena DS, Gupta R and Kocha DK (2005c). Hypoglycemic activity of camel milk in chemically pancreatectomised rats - an experimental study. *International Journal of Diabetes in Developing Countries* (25):75-79.
- Agrawal RP, Budania S, Sharma P, Gupta R, Kochar DK, Panwar RB and Sahani MS (2007a). Zero prevalence of diabetes in camel milk consuming Raica community of north-west Rajasthan, India. *Diabetes Research and Clinical Practice*(76):290-296.
- Agrawal RP, Saran S, Sharma P, Gupta RP, Kochar DK and Sahani MS (2007b). Effect of camel milk on residual beta-cell function in recent onset type 1 diabetes. *Diabetes Research and Clinical Practice* (77):494-495.
- Agrawal RP, Jain S, Shah S, Chopra A and Agarwal V (2011a). Effect of camel milk on glycemic control and insulin requirement in patients with type 1 diabetes: 2-years randomized controlled trial. *European Journal of Clinical Nutrition* (65):1048-1052.
- Agrawal RP, Sharma P, Gafoorunissa SJ, Ibrahim SA, Shah B, Shukla DK and Kaur T (2011b). Effect of camel milk

- on glucose metabolism in adults with normal glucose tolerance and type 2 diabetes in Raica community: a crossover study. *Acta Biomedica* (82):181-186.
- Al-Ayadhi LY and Elamin NE (2013). Camel milk as a potential therapy as an antioxidant in autism spectrum disorder (ASD). *Evidence-based Complementary and Alternative Medicine* (2013):602834.
- Asp NG and Bryngelsson S (2008). Health claims in Europe: new legislation and PASSCLAIM for substantiation. *Journal of Nutrition* (138):1210S-1215S.
- Bashir S and Al-Ayadhi LY (2014). Effect of camel milk on thymus and activation-regulated chemokine in autistic children: double-blind study. *Paediatric Research* (75): 559-563.
- Cardoso RA, Santos RMDA, Cardos CRA and Carvalho MO (2010). Consumption of camel's milk by patients intolerant to lactose. A preliminary study. *Revista Alergica Mexico* (57):26-32.
- Chu ZL, Carroll C, Alfonso J, Gutierrez V, He H, Lucman A, Pedraza M, Mondala H, Gao H, Bagnol D, Chen R, Jones R. M, Behan DP and Leonard JA (2008). Role for intestinal endocrine cell-expressed G protein-coupled receptor 119 in glycemic control by enhancing glucagon-like Peptide-1 and glucose-dependent insulinotropic Peptide release. *Endocrinology* (149):2038-2047.
- Dahlquist GG (1999). Primary and secondary prevention strategies of pre-type 1 diabetes. Potentials and pitfalls. *Diabetes Care* (22):Suppl 2:B4-B6.
- De KS, Keszthelyi D and Masclee AA (2011). Leaky gut and diabetes mellitus: what is the link? *Obesity Reviews* (12):449-458.
- Ehlayel MS, Hazeima KA, Al-Mesaifri F and Bener A (2011). Camel milk: an alternative for cow's milk allergy in children. *Allergy and Asthma Proceedings* (32):255-258.
- El Agamy EI (2007). The challenge of cow milk protein allergy. *Small Ruminant Research* 68:64-72.
- El Agamy EI and Nawar MA (2000). Nutritive and immunological values of camel milk: a comparative study with milk of other species. Second international Camelid Conference: Agro-economics of Camelid Farming. Almaty, Kazakhstan. pp 33-45.
- FAO (2006). The next thing: camel milk. FAO newsroom. <http://www.fao.org/newsroom/en/news/2006/1000275/index.html>
- Fiocchi A (2010). World Allergy Organization (WAO) Diagnosis and rationale for Action against Cow's Milk Allergy (DRACMA) Guidelines. *Pediatric Allergy and Immunology* (21):1-125.
- Korish AA (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. *Hormone and Metabolic Research* 2014.
- Mohamad RH, Zekry ZK, Al Mehdar HA, Salama O, El Shaieb SE, El Basmy AA, Al said MG and Sharawy SM (2009). Camel milk as an adjuvant therapy for the treatment of type 1 diabetes: verification of a traditional ethnomedical practice. *Journal of Medicinal Food* (12):461-465.
- Nauck MA, Bartels E, Orskov C, Ebert R and Creutzfeld W (1993). Additive insulinotropic effects of exogenous synthetic human gastric inhibitory polypeptide and glucagon-like peptide-1-(7-36) amide infused at near-physiological insulinotropic hormone and glucose concentrations. *Journal of Clinical Endocrinology & Metabolism* (76):912-917.
- Nodake Y, Fukumoto S, Fukasawa M, Sakakibara and Yamasaki N (2010). Reduction of the immunogenicity of beta-lactoglobulin from cow's milk by conjugation with a dextran derivative. *Bioscience, Biotechnology and Biochemistry* (74):721-726.
- Reusken CB, Haagmans BL, Mulle MA, Gutierrez C, Godeke GJ, Meyer B, Muth D, Raj VS, Smits-De VL, Corman VM, Drexler JF, Smits, SL, El Tahi YE, De SR, Nowotny N, Hidalgo-Hermoso E, Bosch BJ, Rottier P, Osterhaus A, Gortazar-Schmidt C, Drosten C and Koopmans MP (2013). Middle East respiratory syndrome coronavirus neutralising serum antibodies in dromedary camels: a comparative serological study. *Lancet Infectious Diseases* (13):859-866.
- Sbou A, Khorchani T, Djegham M, Agreb, A, Elhatmi H and Belhadj O (2010). Anti-diabetic effect of camel milk in alloxan-induced diabetic dogs: a dose-response experiment. *Journal of Animal Physiology and Animal Nutrition (Berl)* (94):540-546.
- Shabo Y, Barzel R, Margoulis M and Yagil R (2005). Camel milk for food allergies in children. *Israel Medical Association Journal* (7):796-798.
- Shimshoni R (2014). Effectiveness of camel milk based formulation for treating psoriasis. internet. <http://www.moloko-verblud.narod.ru/links/StudyEng.1.pdf>
- Smits MG, Huppertz T, Altling AC and Kiers JL (2011). Composition, constituents and properties of Dutch camel milk. *Journal of Camel Practice and Research* (18):1-6.
- Smits MG and Monteny GJ (2009). Ammonia emission from camel dairy in the Netherlands. *Journal of Camel Practice and Research* (16):139-142.
- Wernery U, Nagy P and Bhai I (2006). The effect of heat treatment, pasteurisation and different storage temperatures on insulin concentrations in camel milk. *Milchwissenschaft-Milk Science International* (61): 25-28.
- Wernery R, Suntiha J, Bobby J, Sherry J, Milen T, Maria RA and Wernery U (2012). Camel milk against autism - A preliminary report. *Journal of Camel Practice and Research* (19):143-147.
- Yagil R (2013). Camel milk and its unique anti-diarrheal properties. *Israel Medical Association Journal* (15): 35-36.
- Zagorski O, Maman A, Yafee A, Meisles A, Creveld V and Yagi R (1998). Insulin in milk-a comparative study. *International Journal of Animal Sciences* (13):241-244.