

## Role of Goat Milk and Milk Products in Dengue Fever

\*Gunjan Mahendru<sup>1</sup>, P. K. Sharma<sup>1</sup>, V. K. Garg<sup>1</sup>, A. K. Singh<sup>1</sup>, S. C. Mondal<sup>1</sup>

Department of Pharmaceutical Technology, Meerut Institute of Engineering and Technology, Baghpat Bypass, NH-58, Meerut-250005, Uttar Pradesh, India.

**Abstract** Dengue has become a major health problem in India. It is mainly transmitted to humans by *Aedes aegypti* mosquito, which constitutes the etiological agents of the disease. So, for treating this disease goat milk and milk products are mostly preferred. Selenium (Se) is the main component of goat milk. Deficiency of Selenium and decrease in platelet count are the main complications of dengue fever. Goat milk as well as milk products are richest source of Selenium (Se) as comparison to cow and sheep milk. Goat milk also found to help with the digestive and metabolic utilization of various minerals.

**Keywords:** Dengue fever, Goat Milk, Milk Products, Selenium, Platelet Count.

### Introduction

Dengue fever is the major introducing public health problem in India and worldwide, which infect several people annually and for which there is no effective therapy currently exist [1]. Dengue fever is a viral which is transmitted by *Aedes* mosquitoes to humans, normally 50 to 100 million cases occurring annually. The growing urbanization of populations is fail in controlling the spread of this disease by the mosquito vector. Now days, about two and half billion peoples are live in area where transmission of viral of one of the four serotypes of dengue virus can occur [2]. The disease is mostly found in South or Central America, also in some island of the Mexico, Caribbean and as well as tropical and sutropical areas [3, 4]. The infected mosquito that containing the virus, bite to a healthy person then the virus from the infected mosquito will enter through the body's glands. After entering in the glands, these viruses will multiplies and can enter in to the bloodstream. Dengue virus have four serotypes, DEN 1, 2, 3 and 4; each virus is responsible for causing severe dengue and haemorrhagic syndrome [5-7].

Dengue fever affects the people of all age group, but especially in case of children under the age of 15 years. The infection which is caused by one dengue serotype will provides lifelong immunity but other remaining serotypes can eventually infect, several serotypes may be in circulation during epidemic [8- 10]. Dengue and dengue hemorrhagic fever may be an endemic in the sub-continent of Asian, it is declared by WHO. Now a day, dengue is endemic in 112 countries of the world [11]. Dengue is an effective mosquito-borne disease related to

morbidity, mortality in the world [12]. Monocytes, macrophages and mouse neural cells are the cellular receptors, which are the main targets for the viral infection [13]. The virus E-protein plays an important role in attachment of virus to target cells and its interaction with cellular receptors. In dengue fever, mainly decrease in platelet counts takes place [14]. The several preventive measures which can be taken by the person are use of mosquito coils, discarding wastage, or by covering the body when go outside [15]. The main symptoms which are observed in the patients are high body temperature, reddened eye, cold clammy skin and restlessness will feel [16]. If platelet level drops (below 20,000) and there is significant bleeding then platelet transfusion should be provided. To prevent from dehydration high oral fluid is prescribed [17]. Goat's milk ranks fourth after cows, buffaloes and sheep's milk in terms of world milk production. Although goat's milk production was accounts 2.16% of the total world milk production. Goat-keeping has a significant economic importance in countries where climatic conditions are not favourable for cattle keeping. Countries around the Mediterranean region have the most developed dairy goat industries, with France, Greece, Spain and Italy among the main goats' milk-producing countries. There has been an increased interest for goats' milk production and conversion to value-added products was found in the last decade. Changes in social attitudes and increased frequency of travel have resulted in greater consumer awareness and demand for gourmet foods. Goat milk is an alternative milk source for those people who have cow's intolerance found in recent years [18]. Goat milk and milk products helps in the digestive and metabolic utilization of many types of minerals which are iron, calcium, phosphorous and magnesium [19]. Goat milk is mainly prescribing to dengue patients to maintain body fluid balance because transfusion of platelets is not possible from outside in all cases [20]. Biliary secretion of cholesterol increased by goat milk diet and it decrease the

### \*Corresponding Author

Gunjan Mahendru

Meerut Institute of Engineering and Technology, Baghpat Bypass, NH-58, Meerut-250005, Uttar Pradesh, India.

Email: [msgunjan.gunjan@gmail.com](mailto:msgunjan.gunjan@gmail.com)

Mobile No.: +91-7599050724

plasma cholesterol levels, but phospholipids, biliary acid and lithogenic level remain same [19]. On comparison of goat and cow milk it was observed that goat milk have more than 2.5 times the Se powdered infant formula (19.98 mg/l vs. 7.47 mg/l) and nearly 35% greater than pasteurized cow milk (19.98 mg/l vs 14.85 mg/l) present [21]. Dietary goat milk increases the iron bioavailability which helps in recovery from haematological parameter after ferropenic nutritional anaemia by increasing the Fe deposition in the target organs [22]. Better recovery with goat milk was seen in case of ferropenic anaemia and bone demineralisation. Positive effect on metabolism of minerals shows by goat milk [23]. Se deficiency also causes an irreversible cardiomyopathy [24]. In case of auto-immune disease Se control the human immune system by upgrading it when necessary and degrading it when it is overactive. Se also prevents the replication of virus. T cell and interleukin both are the important component of immune system and Se help by increasing the function of T cell or by modulating the production of interleukin [25].

### Composition of goats' milk

There are many factors like parity, season, breed, stages of lactation, nutritional and environmental which affect the composition of goat milk [26]. In goat milk more than 27% selenium is present as compared to cow milk [27]. Large difference in composition was seen in the single animals of the same breed which is related to an extensive and complex genetic polymorphism of the goats' milk casein [28]. Five principal proteins are present in goat milk  $\alpha$ -lactalbumin,  $\beta$ -lactoglobulin,  $\kappa$ -casein,  $\beta$ -casein, and  $\alpha_{s2}$ -casein [29].

### Difference between Goat milk over Cow Milk

Goat milk in reality is very safe product in many important ways and naturally homogenized. Goat milk is very easy to digest than cow milk and in goat milk, lesser amount of proteins molecules are present than cow milk and fat molecules in goat milk have thinner, more fragile membrane or half of the size of those in cow milk [30]. Difference in composition between cow and goat milk are given in (Table 1).

**Table 1:** Difference in composition between goat and cow milk [31, 32, 33, 27].

Constituents	Goat	Cow
Protein (%)	3.4	3.2
Lactose (%)	4.1	4.7
Fat (%)	3.8	3.6
Ash (%)	0.77	0.71
Vitamin A (I.U)	120	158
Vitamin B1 (mg)	0.05	

### Biochemistry and Processing of Goat Milk and Other Milk Products

When goat milk is used single or mixed with other animal milk such as cow or buffalo, then it give various valuable products such as dried milk product, ghee (clarified butter fat), dahi (curd), yogurt, khoa (heat-desiccated milk product), channa (acid and heat coagulated milk product), and cheese (paneer, cheddar, mozzarella and gouda) [34].

### Beneficial Effects of Goats Milk to Health than Cow's Milk in Case of Dengue

On comparison of goat's milk with cow's milk it was observed that goat milk help in the digestive and metabolic utilization of several minerals such as Fe, calcium, phosphorous and magnesium and it also help in prevention of various diseases like anaemia and bone demineralization. In case of ferropenic anaemia and bone demineralisation better recovery with goat milk was seen. Goat milk also has positive effect on metabolism of minerals [23]. It is also used as a substitute for the patients who are allergic to cow milk [35].

### Role of Selenium (Se) in Dengue Fever

Selenium(Se) is also called by the name selenoprotein, it is the one of the most essential micronutrient which is incorporated in to about 25 proteins. Mostly selenoproteins are act as enzymes, they protect from cellular damages which is caused due to the formation of by-product of oxygen metabolism because of its antioxidant property [36, 24]. Se-enriched product, milk product, plant food that are grown in Se rich soils and animals that graze on this soils are the main dietary sources of this micronutrient [37].

Selenium(Se) shows its effect on the thromboxane / prostacycline ratio, because of this nature it shows role in the regulation of blood clotting and it also shows its effects on the complement system. Se has an anticlotting effect where as, thrombotic or proclotting effects are mainly observed due to the Se deficiency. Haemorrhagic effects in animals are mainly associated with the extreme dietary Se deficiency which is never seen in humans [38]. The replication of virus is prevent by Se, T cell and interleukin both are the important component of immune system and Se help by modulating the production of interleukin or by increasing the T cell function [25]. The main mechanism of causing severity in host pathology and viral mutations mainly remains unknown. Oxidative stress and host immune response are the causes of Se deficiency [39, 40]. By incorporation of Se as selenocysteine in GPx, helps significantly help immune responses of host and antioxidant protection [41]. Increased of harmful effect and development of viral quasispecies are also leads to the deficiency of Se [42, 43]. Se containing food pills and animal product may prevent human being from Se deficiency [37].

### Structure of Dengue Virus

The structure of dengue virus has been developed by the help of using combination of cryoelectron microscopy and by setting the structure of glycoprotein E into the electron density map which permit the visualization of various component of several proteins [44, 45]. For the specific encapsidation of the RNA genome C protein is most essential of the dengue virus [46]. On the entering of envelope glycoprotein E of the dengue virus will binds to the receptor and by rearrangement or reducing the pH of an endosome it show its action. Fusion between viral and host cell membrane will produce by conformational changes [47]. E protein of dengue virus is glycosilated and it favours the fusion with cell membrane by showing its attachment to the cellular receptors [14].

### Symptoms and Diagnosis of Dengue Fever

Dengue is an infection of short duration; it shows several symptoms like rashes, headache, fever and severe pain in the muscles and joints during an incubation period of 5-8

days, recovery is commonly seen although convalescence may be long. In case of more severe form, internal bleeding and severe dengue shock syndrome are produced mostly in infants and young children [48, 49]. On high fever, temperature as high as 104°F, reddened eyes, weak rapid pulse, cold clammy skin and restlessness will feel. Renal impairment, meningo-encephalities and change in the function of many organs will occur due to the dengue infection [16]. Primary infection of this result is a self-limiting disease which is ranges from mild to high fever lasting up to 3 to 7 days, severe headache with pain behind the eyes, muscle, joint pain and rash also observed [50, 51].

Secondary infection is the common form of dengue virus serotype; the main clinical symptoms are high fever, hemorrhagic events, circulatory failure and fatality rate, if proper treatment is not given to the patient than may die within 12 to 24 hr [52]. After the onset of symptoms, increase in specific IgM was seen with in 3 to 5 days which generally persists for 30 to 60 days [53]. After 10 to 14 days of infection increase in IgG level observed, and it can be detectable for life, through at a haemagglutination inhibition assay, during secondary infection IgG levels generally increase more slowly and then come at lower level in primary infection, but IgG level increased rapidly from 1 to 2 days after the onset of symptoms [52].

Diagnosis of dengue fever can be done by various methods for the detection of level of immunoglobulin IgG and IgM like: Haemagglutination Inhibition Assays (HAI): Traditionally acetone or kaolin treated method was used for diagnosing sera which requires collection of sera 7 days apart variance in terms of haemagglutinin potency, but this method resulted in several doubts as assessed in terms of general applicability [52, 54].

ELISA: Serial dilution is not required in case of pre-treatment; diagnosis can be performed from a single serum specimen [54]. For each test sample the number of antibody unit was calculated by this formula [55].

$$\frac{OD(\text{Test}) - OD(\text{NC})^*}{OD(\text{Weak PC})^{**} - OD(\text{NC})} \times 100$$

\*NC: Negative control, \*\*Weak PC: Weak positive control

### Treatments

To get prevention from this disease no accurate vaccine treatment is available. By taking some rest, increasing oral fluid intake and by using acetaminophen in about 2 weeks to a month people may recover from this infection, but never recommend an aspirin to the patients because it may increases the risk for severe bleeding. If patient is not able to take oral fluid then supplementation can be done with intravenous fluids which help in prevent from dehydration and maintain concentration of blood. If the level of platelet drops (below 20,000) or if significant bleeding occurs then platelet transfusion should be given. Goat milk and milk products are also recommended for those severe cases. Platelet or red blood cell transfusion is given in the presence of melena; indicate gastrointestinal bleeding [56, 17].

### Preventive Measures to Control Dengue Fever

1. Use mosquito coils and electric vapors mats during the day to prevent from dengue.
2. Discard all wasted items getting gathered around the living area to avoid the breeding of mosquitoes.

3. Patients suffering from dengue-fever must be isolated for at least 5 days.

4. Keep the water stores clean and closed.

5. Keep yourself well covered when outside.

6. Take prompt medical advice once fevers starts [15, 57].

### Conclusion

For treating dengue fever goat milk and milk products are very helpful because they directly modulate the human immune system. In this review it can be concluded that the dengue fever is managed with goat milk and its products.

### Conflict of interest

There is no conflict of interest among authors.

### References

1. Xu T, Sampath A, Chao A, Wen D, Nanao M, Chene P, Vasudevan SG and Lescar J. Structure of the Dengue Virus Helicase/Nucleoside Triphosphatase Catalytic Domain at a Resolution of 2.4 Å. *J. Virol.* 2005; 79(16): 10278-88.
2. Phillips ML. Dengue Reborn: Widespread Resurgence of a Resilient Vector. *Environ Health Perspect.* 2008; 116(9): A382-A88.
3. Gubler DJ and Trent DW. Emergence of epidemic dengue/dengue haemorrhagic fever as a public health problem in the Americas. *Infect Agents Dis.* 1994; 2(6): 383-93.
4. Uzcategui NY, Comach G, Camacho D, Saludo M, Quintana MCD, Jimenez M, et al. Molecular epidemiology of dengue virus type 3 in Venezuela. *J Gen Virol.* 2003; 84(6): 1569-75
5. Gubler DJ. Dengue Viruses. *Encyclopedia of Virology.* 2008: 5-14.
6. Stephen H W MPH and Gubler D J. Dengue Fever. *Clin. Dermatol.* 1989; 7(1): 117-22.
7. Henchal E A and Putnak J R. The dengue viruses. *Clin Microbiol Rev.* 1990; 3(4): 376-96.
8. Chaturvedi UC and Shrivastava R. Dengue haemorrhagic fever: global challenge. *Indian J Med Microbiol.* 2004; 22(1): 5-6.
9. Franchini G, Ambinder RF and Barry M. Viral disease in hematology. *Hematol.* 2000; 1: 409.
10. Bharaj P, Chahar H S, Pandey A, Diddi K, Dar L, Guleria R et al., Concurrent infection by all four dengue virus serotypes during an outbreak of dengue in 2006 in Delhi, India. *Virol J.* 2008; 5: 1.
11. Guzman MG and Kouri G. Dengue. *Lancet Infect Dis.* 2002; 2(1): 33-42.
12. Hemingway J, Beaty BJ, Rowland M, Scott TW and Sharp BL. The innovative vector control consortium: improved control of mosquito borne disease. *Trends Parasitol.* 2006; 22(7): 308-12.
13. Jorge RDV, Salvador CS, Fernando M and Rosa MDA. Heat Shock Protein 90 and Heat Shock Protein 70 Are Components of Dengue Virus Receptor Complex in Human Cells. *J. Virol.* 2005; 79(8): 4557-67.
14. Kurane I. Dengue hemorrhagic fever with special emphasis on immunopathogenesis. *Comp. Immun. Microbiol. Infect. Dis.* 2007; 30: 329-40.
15. Fradin MS and Day JF. Comparative efficacy of insect repellents against mosquito bites. *N Engl J Med.* 2002; 347(1): 13-18.

16. Anthony SY, Wong KT, Trishe YML, Puay HT, Pong SW. The pathology of dengue hemorrhagic fever. *Semin Diagn Pathol.* 2007; 24(4): 227-36.
17. Dengue Fever. The Bali Weekly Posted on 4 march 2010.
18. Goat milk a tzipoula-clarke. *Encyclopedia of dairy sciences.* 1270-79.
19. Aliaga IL, Castro JD, Alferez MM, Barrionuevo M, Campos MS. A review of the nutritional and health aspects of goat milk in cases of intestinal resection. *Dairy Sci Technol.* 2010; 90(6): 611-12.
20. Dengue cure rumour spikes goat milk price. *India Today.* Available from: <http://indiatoday.intoday.in/site/story/delhi-clinics-sting-dengue-patients/1/115926.html>.
21. Rodriguez EM, Alaez S, Romero DC. Chemometric studies of several minerals in milks. *J. Agric. Food Chem.* 1999; 47(4): 1520-24.
22. Maria JMA, Inmaculada LA, Teresa N, Javier DC, Mercedes B, Patricia BR and Margarita SC. Dietary goat milk improves iron bioavailability in rats with induced ferropenic anemia in comparison with cow milk. *Int Dairy J.* 2006; 16(7): 813-21.
23. Science Daily. Available from: <http://www.sciencedaily.com/releases/2007/07/070730100229.htm>. 2007.
24. Morgan KC, Esteveg AO, Muller CL, Valadez BC, Vizuet AM, Szewczyk NJ et al. The glutaredoxin GLRX-21 functions to prevent selenium-induced oxidative stress in caenorhabditids elegans. *Toxicol. Sci.* 2010; 118(2): 530-43.
25. Goldenberg RL. The Plausibility of Micronutrient Deficiency in Relationship to Perinatal Infection. *J. Nutr.* 2003; 133(5): 1645S-1648S.
26. Ozrenk E, Inci SS. The effect of seasonal variation on the composition of cow milk in van province. *Pakistan J Nutrition.* 2008; 7(1): 161-64.
27. Belew MA and Adewole AM. Goat milk: A feasible dietary based approach to improve the nutrition of orphan and vulnerable children. *Pakistan J Nutrition.* 2009; 8 (10): 1711-14.
28. Jenness R. Composition and Characteristics of Goat Milk. *J Dairy Sci.* 1980; 63(10): 1605-63.
29. Wal JM. Structure and function of milk allergens. *Eur. J. Allergy Clin. Immunol.* 2001; 56(67): 35-38.
30. Attaie (2000) and Jensen. Goat milk magic: one of life's greatest healing foods. *J. Dairy Sci.* 1994; 83: 940-44.
31. Haenlein GFW and Caccese R. Difference between cow and goat milk. *United Caprine News* available from: <http://HealthNews-NZ.Com>. 1989.
32. Eddleman H. Composition of human, cow and goat milk. Draft 1 available from: <http://GoatWorld.com>. 1999.
33. Maree HP. Goat milk and its use as a hypo-allergenic infant food. *Dairy Goat Journal.* Available from: [http://goatconnection.com/articles/publish/article\\_152.shtml](http://goatconnection.com/articles/publish/article_152.shtml). 1978.
34. Agnihotri MK and Prasada VSS. Biochemistry and processing of goat milk and milk products. *Small Ruminant Res.* 1993; 12(2): 151-70.
35. Park YW. Hypo-allergenic and therapeutic significance of goat milk. *Small Ruminant Res.* 1994; 14: 151-59.
36. Moghadaszadeh B and Beggs AH. Selenoproteins and their impact on human health through diverse physiological pathways. *Physiol.* 2006; 21(5): 307-15.
37. Gupta C, Gupta UC and Subhas. Selenium deficiency in soils and crops and its impact on animal and human health. *Curr Nutr Food Sci.* 2010; 6(4): 268-80.
38. Ramnathan CS and Taylor EW. Computational genomic analysis of hemorrhagic fever virus viral selenoproteins as a potential factor in pathogenesis. *Biol Trace Elem Res.* 1997; 56(1): 93-106.
39. Saito Y, Yoshida Y, Akazawa T, Takahashi K and Niki E. Cell death caused by selenium deficiency and protective effect of antioxidants. *J. Biol. Chem.* 2003; 278(41): 39428-34.
40. Prabhu KS, Zamamiri DF, Stewart JB, Thompson JT, Sodillo LM and Reddy C. Selenium deficiency increase the expression of inducible nitric oxide synthase in RAW 264-7 Macrophage: role of nuclear factor- kappa B in up regulation. *Biochem J.* 2002; 366: 203-09.
41. Verma S, Molina Y, Lo YY, Cropp B, Nakano C, Yanagihara R et al. In vitro effect of selenium deficiency on west Nile virus replication any cytopathogenicity. *Virology.* 2008; 5: 66.
42. Akaike T, Fujii S, Kato A, Yoshitake J, Miyamoto Y, Sawa T, et al. Viral mutation accelerated by nitric oxide production during infection in vivo. *FASEB J.* 2000; 14(10): 1447-54.
43. Beck MA and Levander OA. Host nutritional status and its effect on viral pathogen. *J Infect Dis.* 2000; 182(1): S93-6.
44. Christopher TJ, Lixin M, John WB, Teresa DG, Carol BP and Richard JK. Flavivirus capsid is a dimeric alpha- helical protein. *J Virol.* 2003; 77(12): 7143-49.
45. Kuhn JR, Zehang W, Rossmann MG, Pletnev SV, Corver J, Lenches E, et al. Structure of dengue virus: implications for flavivirus organization, maturation, and fusion. *Cell.* 2002; 108(5): 717-25.
46. Lixin M, Christopher T J, Teresa D G, Richard K T and Carol B P. Solution structures of dengue virus capsid protein reveals another fold. *Proc Natl Acad Sci U S A.* 2004; 101(10): 3414-19.
47. Yorgo M, Steven O, David C and Stephen CH. Structure of the dengue virus envelope protein after membrane fusion. *Nature.* 2004; 427: 313-19.
48. Halstead SB. Selective primary health care: strategies for control of disease in the developing world. *XI. Dengue. Clin Infect Dis.* 1984; 6(2): 251-64.
49. Siler JF, Milton WH and Hitchens AP. Dengue in Its History, Epidemiology, Mechanism of Transmission, Etiology, Clinical Manifestations, Immunity, and Prevention. *Philippine J Sci.* 1926; 29: 1-302.
50. Monath TP and Heinz FX. Flaviviruses. In B. N. Fields, D. M. Knipe, and P. M. Howley (ed.), *Virology.* 1996; 1016-21.
51. Nimmannitya S. Clinical management of dengue fever/dengue haemorrhagic fever/dengue shock syndrome. *Dengue Bull.* 1996; 20: 13-19.
52. Sang CT, Hoon LS, Cozzubbu A and Peter D. Clinical Evaluation of a Rapid Immunochromatographic Test for the Diagnosis of Dengue Virus Infection. *Clin. Diagn. Lab. Immunol.* 1998; 5(3): 407-09.
53. Lam SK. Rapid dengue diagnosis and interpretation. *Malays J Pathol.* 1993; 15(1): 9-12.
54. Vaughn WD, Nisalak A, Kalyanarooj S, Solomon T, Dung NM, Cuzzubbu A, et al. Evaluation of a rapid Immunochromatographic Test for diagnosis of dengue virus infection. *J Clin Microbiol.* 1998; 36(1): 234-38.

55.Sathish N, Vijayakumar TS, Abraham P and Sridharan G. Dengue Fever: Its laboratory diagnosis, with special emphasis on IgM detection. *Dengue Bull.* 2003; 27: 116-25.  
56.Perez JGR, Clark GG, Gubler DJ, Reiter P, Sander EJ and Vorndam AV. Dengue and dengue haemorrhagic fever. *The Lancet.* 1998; 352: 971-77.

57.Ibrahim NK, Abalkhail B, Rady M, Al- Bar H. An Educational Programme on dengue fever prevention and control for females in jeedah high schools. *East. Mediterr. Health J.* 2009; 15(5): 1058-67.

**Conflict of Interest :- None.**

**Source of Funding :- NA**