

Donkey Milk and its Potential Benefits- A Review

Amaranath Gundluru¹, Kimeera Ambati² & Subhosh Chandra, M.^{1*}

¹Department of Microbiology, Yogi Vemana University, Kadapa.

²Department of Home Science, Sri Padmavati Mahila Visvavidyalayam, Tirupati.

*chandra298@gmail.com

ABSTRACT

Milk of a mammalian was specially designed for the slight immunization with the help of the colostrum and the transition milk, which fulfills the nutritional requirements of the new born infants. Donkey milk has been well known for its therapeutic, cosmetic and nutritional aspects from the ancient times. The donkey milk was suggested for the orphan babies and infants who are sick with different infectious diseases. Recently due to nutritional composition which is equal to the human milk and having very good probiotic properties and disease prevention characteristics is giving a new insight to the human life. Furthermore, the important characteristics like anti-microbial, anti-inflammatory, anti-diabetic, anti-allergy with good nutritional profile with essential proteins, essential fatty acids help in the healthy life. This study gives the healthy prospects of benefits of non-ruminant milk and the future prospects of the donkey milk

Keywords- Donkey milk, anti-inflammatory, anti-diabetic, anti-allergy, probiotics.

1. INTRODUCTION

In the present scenario, the human kind is marching towards the solutions for the healthy and balanced life and to find the best nutritious food for regular consumption. To compensate the worlds demand on healthy life, the donkey's milk is the best alternative for the ruminant milk. It is very healthy and also possesses many probiotics which help in improving the nutritional status of individuals [1]. The non ruminant milk has been found to have different potential probiotics as shown in the Figure 1.

The donkey milk presents the important characteristic in the preservation of the hygienic quality of the milk due to the presence of the high level of lactoferrin which is approximately 1.5 – 3.7g/l in different breeds [2]. The lactose promotes the growth and viability of the probiotics. The lactobacillus strains help in strengthening the antimicrobial activity against the pathogenic organisms in the gastrointestinal tract [3].

The isolated probiotic strains from donkey milk have the functional properties like ACE-inhibitory, antimicrobial and antioxidant activities[4]. These probiotic strains are utilized by the food industries in food microbiology for bio-safety and bio-preservation. They are best for food industry and helps in the

production of probiotic fermented beverages which effectively delivers the probiotics to the human gut. All the strains of probiotics of donkey milk have good potential properties [5].

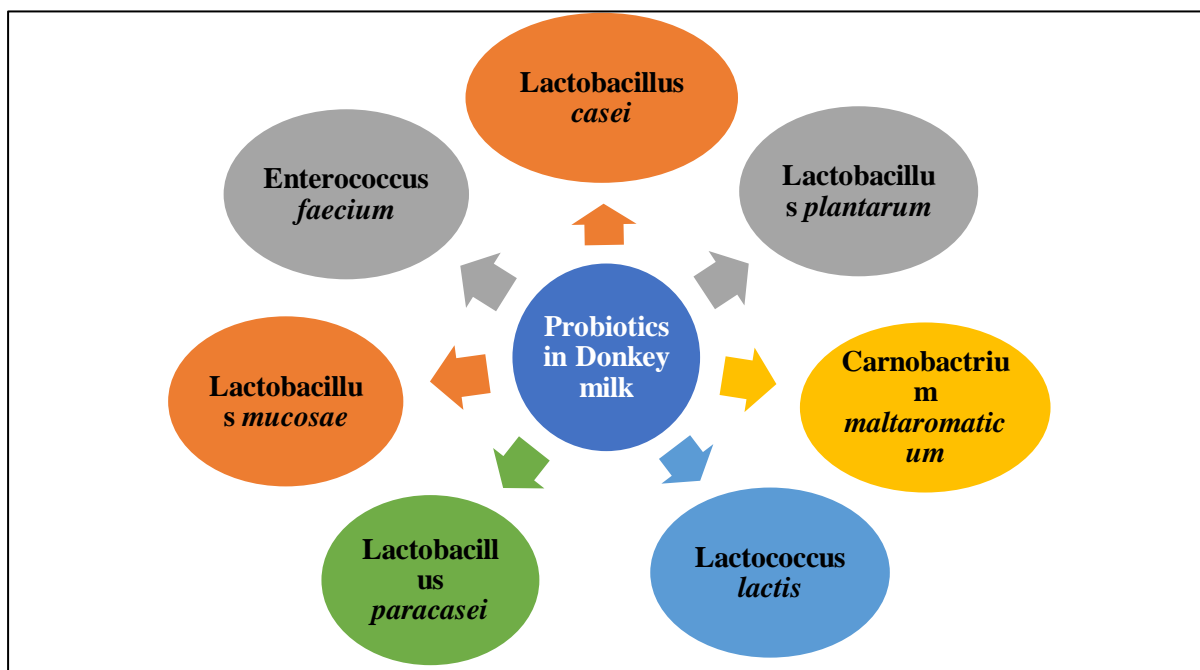


Figure 1- Potential Probiotics from Donkey milk [6-9]

Even though the donkey milk is less exploited of the nutritional properties and potential properties like health benefits, it is gaining a lot of acceptance throughout the world. Infants who suffer from protein intolerances due to the consumption of cow's milk, are frequently using the donkey milk as an alternative. The nutritional profile of donkey milk is widely similar to the human breast milk [10]. In India, most of the rearing of donkeys is done hard working, draught or as pack animals. This study will help in bringing the new insights to the local people to understand the benefits of donkey milk and also recognize the health benefits achieved by consumption of donkey milk [11].



Figure 2- Donkey's from Andhra Pradesh region

2. DONKEY MILK AND ITS DIGESTIBILITY

The lactose in the donkey milk is the major component and is the potential energy source. In the infant stage the absorption of the intestinal calcium is high thereby hindering the bone mineralization. The donkey milk has the similar carbohydrates to the human milk, but the in lesser amounts [12-14]. The carbohydrates which are present in donkey milk are disialyl-lacto-*N*-tetraose, 6-sialyllactose and 3-sialyllactose which conform the good suitability for the consumption of the infants and is very important due to their potentiality in the healthy growth of the intestinal flora and helps in the protection against the viral and bacterial infections [16].

The consumption of the donkey milk does not promote the acid coagulation unlike the cows milk and therefore, helps in the easy digestion and is more suitable for the infant nutrition [17]. Recent studies showed 93% of casein is digested and only 7% is left after the digestion. The β -lactoglobulins, type I and II are most digestible and the α -lactalbumin has been seen to reach the intestinal gut very intact [18]. The lysozyme, another resistant protein which helps in the inhibition of the sensitive bacteria in the gut [19].

The fatty acids present are very important from the point of nutrition as they contain the unsaturated fatty acids and short chain fatty acids. Most of the long chain fatty acids in the donkey milk are similar to the human milk. The palmitic acid plays an important role in the process of lipolysis and the fatty acid bioavailability and their potential health benefits on health [20].

The good vitamin and mineral content gives the favorable conditions for the good absorption of the calcium present in the donkey milk [21].

3. HEALTH BENEFITS

- * **Milk protein allergy-** The lysozyme, lactoferrin and lactoperoxidase which are present in donkey milk have found to be having the antimicrobial properties and act as the bacteriostatic agents help in prevention of the milk protein allergy and the donkey milk suits as the best substitute for cows milk in infants. The chemical composition and especially the protein content of the donkey milk is close to the human milk and can be used for the children [22].
- * **Lactose intolerance-** The main carbohydrate in the human milk, ruminant milk, different non-bovine milk is lactose. The lactose in the milk is responsible for osmotic equilibrium between the alveolar lumen and the blood in the mammary glands. It has the two forms α -lactose and β -

lactose and form the basis for the glycosylic bond which connects the glucose and galactose. In the adult population the lactose intolerance is most common due to the inability to produce sufficient lactase or due to the absence of the intestinal lactase. The low levels of lactose are tolerable by such people. The donkey milk contains very low levels of lactose thereby used for the consumption in the individuals who suffer from lactose intolerance [23].

- * **Diabetes-** the consumption of donkey milk helps in the prevention and in the treatment of the diabetes. The beneficial glucometabolic properties of donkey milk and their active components and the biological processes help in the maintenance of the diabetes. The consumption of donkey milk has improved the glucose disposal and insulin resistance, which helps in the reduction in the glucose levels and better tolerance of the glucose loads. The study proved that it has the anti-diabetic effect [24-25].
- * **Hypertension-** The donkey milk has potential characteristics of angiotensin-converting enzyme, inhibitory peptides which also help in reducing the activity. The milk derived bioactive peptides have the potentiality of decreasing the formation of the angiotensin -II and increase in the bradykinin levels, which have the vasoconstrictor and vasodilator properties. The particular effect acts as synergistic and helps in the lowering of the hypertension.
- * **Cancer-** The donkey milk was observed to have the antiproliferative and antitumor effect. They have proved that the consumption of donkey milk can help in the activation of lymphocytes and macrophages which helps in reducing the primary tumor size and inhibits the tumor progression by inducing the apoptosis [26-27].
- * **Anti-inflammatory-** The α -lactoalbumin and β -lactoglobulin as proved to have the reduction properties of the mediators of the inflammation but also have the protective properties of the intestinal mechanical barrier function. The donkey milk has the indirect action on the intestinal immunity thereby showing the anti-inflammatory properties and helping in the immune development and regulation from the early life [28-29].
- * **Cosmetic properties-** the donkey milk is used in making of the moisturizers. The donkey milk is used in hydration therapies combined with the antioxidant action which helps in preventing the aging. the content present in the donkey milk helps in nourishing the skin and giving a soft texture. The vitamins and poly unsaturated fatty acids along with anti-aging, anti-oxidant and regenerating compounds, which help in natural skin hydration and delay in aging [30-32].

4. CONCLUSION

The donkeys have shared a great history from the ancient times. They are used for agricultural activities. They were used in the making of cosmetics from the donkey milk. During the 20th century it has been

reported that the sick children, orphaned children were fed with the donkey milk and it is less allergic when compared to the cow milk. It has the good nutritional profile with all the macro and micro nutrients in the required quantity and is equal to the nutritional profile of the human milk. Hence a very good alternative for the infants. It has various health benefits like it is anti-diabetic, anti-hyper tensive, anti-tumor, anti-inflammatory, helps in boosting the intestinal immunity, has the probiotic properties improving the gut health. Apart from that the donkey milk helps in improving the lung infections due to its good protein content. As it is a good source of calcium and vitamin -D also helps in the osteoporosis and osteomalacia. They are also used in the cosmetic industry, in the formation of soaps, fairness creams etc.

5. FUTURE PERSPECTIVES

Even though the donkey has been shunned aside. Recently due to the growing research, the donkey milk is going to become the greatest treasure in the cosmetic field, nutrition field and in the medical field. Local people are only using the donkey for marginal labor, load carrying but are unaware of the economic benefits. By making them aware of the benefits of the donkey and its milk, the future prospects are really huge with proper breeding, milking and product marketing.

SOURCES OF SUPPORT: NONE

SHORT RUNNING HEAD: Donkey Milk and its Potential Benefits- A Review

CONFLICT OF INTEREST: There are NO conflicts of interest

ACKNOWLEDGE: I thank my Research Supervisor Dr. Subhosh Chandra, M., for his continuous guidance and support during the study and Ms. Kimeera Ambati for her cooperation and help in my study.

REFERENCES

1. Elisabetta S, Francesco F. Equid milk for human consumption. *Int Dairy Journal*. 2012; 24: 130-142.
2. Aganga AA, Lesto M, Aganga AO. Feeding donkeys. *Livest Res Rural Dev*. 2000; 12: 1-5.
3. Cosentino C, Freschi P, Paolino R, Valentini V. Market sustainability analysis of jenney milk cosmetics. *Emir J Food Agric*. 2013; 25: 635-640.
4. Bhardwaj A, Pal Y, Legha RA, Sharma P, Nayan V, et al. Donkey milk composition and its therapeutic applications: Review. *Indian Journal of Animal Sciences*. 2020; 90: 837-841.
5. Chiavari C, Coloretti F, Nanni M, Sorrentino E, Grazia L. Use of donkey's milk for a fermented beverage with lactobacilli. *Lait*, 2005; 85: 481-490.
6. Aspri M, Leni G, Galaverna G, Papademas P. Bioactive properties of fermented donkey milk, before and after in vitro simulated gastrointestinal digestion. *Food Chemistry*. 2018; 268: 476-484.

7. del Rio MDS, Andrighetto C, Dalmasso A, Lombardi A, Civera T, et al. Isolation and characterisation of lactic acid bacteria from donkey milk. *Journal of Dairy Research* 2016; 83: 383-386.
8. Murua A, Todorov SD, Vieira ADS, Martinez RCR, Cencic A., et al. Isolation and identification of bacteriocinogenic strain of *Lactobacillus plantarum* with potential beneficial properties from donkey milk. *J Appl Microbiol.* 2013; 114: 1793-1809.
9. Rastogi S, Mittal V, Singh A. In Vitro Evaluation of Probiotic Potential and Safety Assessment of *Lactobacillus mucosae* Strains Isolated from Donkey's Lactation. *Probiotics and Antimicrobial Proteins.* 2020; 12: 1045-1056.
10. Vincenzetti S, Savini M, Cecchini C, Micozzi D, Carpi F, Vita A, et al. Effects of Lyophilization and Use of Probiotics on Donkey's Milk Nutritional Characteristics. *Int J Food Eng* 2011; 7: 1-16.
11. Carroccio A, Mansueto P, Iacono G, Soresi M, D'Alcamo A, et al. Non-Celiac Wheat Sensitivity Diagnosed by Double-Blind Placebo-Controlled Challenge: Exploring a New Clinical Entity. *The American journal of gastroenterology.* 2012; 107.
12. Lönnnerdal B, Erdmann P, Thakkar SK, Sauser J, Destaillets F. Longitudinal evolution of true protein, amino acids and bioactive proteins in breast milk: a developmental perspective. *Journal of Nutritional Biochemistry.* 2017; 41: 1-11.
13. Aspri M, Leni G, Galaverna G, Papademas P. Bioactive properties of fermented donkey milk, before and after in vitro simulated gastrointestinal digestion. *Food Chemistry.* 2018; 268: 476-484. 11. Massouras T, Bitsi N, Paramithiotis S, Manolopoulou E, Drosinos EH, et al. Microbial Profile Antibacterial Properties and Chemical Composition of Raw Donkey Milk. *Animals.* 2020; 10: 2001.
14. Vita D, Passalacqua G, Di Pasquale G, Caminiti L, Crisafulli G, Rulli I, et al. Ass's milk in children with atopic dermatitis and cow's milk allergy: crossover comparison with goat's milk. *Pediatr Allergy Immunol* 2007; 18: 594-598.
15. Monti G, Viola S, Baro C, Cresi F, Tovo PA, Moro G, et al. Tolerability of donkey's milk in 92 highly-problematic cow's milk allergic children. *J Biol Regul Homeost Agents.* 2012; 26: 75-82.
16. American Academy of Pediatrics. Committee on Nutrition Hypoallergenic Infant Formulas. *Hypoallergenic Infant Formulas.* *Pediatrics* 2000; 106: 346-9.
17. Polidori P, Vincenzetti S. Use of Donkey Milk in Children with Cow's Milk Protein Allergy. *Foods.* 2013 May 6;2(2):151-159. doi: 10.3390/foods2020151. PMID: 28239105; PMCID: PMC5302262.
18. Ugidos-Rodríguez, S.; Matallana-González, M.C.; Sánchez-Mata, M.C. Lactose malabsorption and intolerance: A review. *Food Funct.* 2018, 9, 4056–4068.
19. Altomonte, I.; Salari, F.; Licitra, R.; Martini, M. Donkey and human milk: Insights into their compositional similarities. *Int. Dairy J.* 2019, 89, 111–118.
20. Mao, X.; Gu, J.; Sun, Y.; Xu, S.; Zhang, X.; Yang, H.; Ren, F. Anti-proliferative and anti-tumour effect of active components in donkey milk on A549 human lung cancer cells. *Int. Dairy J.* 2009, 19, 703–708.
21. Li, Y.; Fan, Y.; Shaikh, A.S.; Wang, Z.; Wang, D.; Tan, H. Dezhou donkey (*Equus asinus*) milk a potential treatment strategy for type 2 diabetes. *J. Ethnopharmacol.* 2020, 246, 112221.

22. Trinchese, G.; Cavaliere, G.; De Filippo, C.; Aceto, S.; Prisco, M.; Chun, J.T.; Penna, E.; Negri, R.; Muredda, L.; Demurtas, A.; et al. Human Milk and Donkey Milk, Compared to Cow Milk, Reduce Inflammatory Mediators and Modulate Glucose and Lipid Metabolism, Acting on Mitochondrial Function and Oleyethanolamide Levels in Rat Skeletal Muscle. *Front. Physiol.* 2018, 9, 32.
23. Trinchese, G.; Cavaliere, G.; Canani, R.B.; Matamoros, S.; Bergamo, P.; De Filippo, C.; Aceto, S.; Gaita, M.; Cerino, P.; Negri, R.; et al. Human, donkey and cow milk differently affects energy efficiency and inflammatory state by modulating mitochondrial function and gut microbiota. *J. Nutr. Biochem.* 2015, 26, 1136–1146.
24. Cunsolo, V.; Saletti, R.; Muccilli, V.; Gallina, S.; Di Francesco, A.; Foti, S. Proteins and bioactive peptides from donkey milk: The molecular basis for its reduced allergenic properties. *Food Res. Int.* 2017, 99, 41–57.
25. Aspri, M.; Leni, G.; Galaverna, G.; Papademas, P. Bioactive properties of fermented donkey milk, before and after in vitro simulated gastrointestinal digestion. *Food Chem.* 2018, 268, 476–484.
26. Li, Q.; Li, M.; Zhang, J.; Shi, X.; Yang, M.; Zheng, Y.; Cao, X.; Yue, X.; Ma, S. Donkey milk inhibits triple-negative breast tumor progression and is associated with increased cleaved-caspase-3 expression. *Food Funct.* 2020, 11, 3053–3065.
27. Esener, O.; Balkan, B.; Armutak, E.; Uvez, A.; Yildiz, G.; Hafizoglu, M.; Yilmazer, N.; Gurel-Gurevin, E. Donkey milk kefir induces apoptosis and suppresses proliferation of Ehrlich ascites carcinoma by decreasing iNOS in mice. *Biotech. Histochem.* 2018, 93, 424–431.
28. Jiang, L.; Lv, J.; Liu, J.; Hao, X.; Ren, F.; Guo, H. Donkey milk lysozyme ameliorates dextran sulfate sodium-induced colitis by improving intestinal barrier function and gut microbiota composition. *J. Funct. Foods* 2018, 48, 144–152.
29. Yvon, S.; Olier, M.; Leveque, M.; Jard, G.; Tormo, H.; Haimoud-Lekhal, D.A.; Peter, M.; Eutamène, H. Donkey milk consumption exerts anti-inflammatory properties by normalizing antimicrobial peptides levels in Paneth's cells in a model of ileitis in mice. *Eur. J. Nutr.* 2018, 57, 155–166.
30. Martini, M.; Altomonte, I.; Tricò, D.; Lapenta, R.; Salari, F. Current Knowledge on Functionality and Potential Therapeutic Uses of Donkey Milk. *Animals* 2021, 11, 1382.
31. Brumini D, Criscione A, Bordonaro S, Vegarud G E and Marletta D. 2016. Whey proteins and their antimicrobial properties in donkey milk: a brief review. *Dairy Science and Technology* 96: 1–14.
32. Martini M, Altomonte I and Salari F. 2014. Amiata Donkeys: Fat globule characteristics, milk gross composition and fatty acids. *Italian Journal of Animal Science* 13(1): 3118.