



Available online through

www.jbsoweb.com

ISSN 2321 - 6328

## Review Article

### A REVIEW ON DONKEY MILK AS ADJUVANT DIETOTHERAPY WITH ANTI-TUBERCULOSIS TREATMENT

Mohmmad Abdulla<sup>1\*</sup>, Abrar Mohd Khan<sup>2</sup>, Mohammad Asif Qurashi<sup>2</sup>, Syed Abshar Ali<sup>3</sup>

<sup>1</sup> Research Officer In charge, Clinical Research Unit, Bhopal, under CCRUM, Ministry of Ayush, Govt. of India.

<sup>2</sup> Research Associate (U), Clinical Research Unit, Bhopal, under CCRUM, Ministry of Ayush, Govt. of India.

<sup>3</sup> Senior Research Fellow (U), Clinical Research Unit, Bhopal, under CCRUM, Ministry of Ayush, Govt. of India.

\*Corresponding Author Email: drabdulla786@gmail.com

Article Received on: 20/03/24 Accepted on: 24/04/24

**DOI: 10.7897/2321-6328.12393**

#### ABSTRACT

Tuberculosis is a communicable disease which has taken epidemic form with increasing burden worldwide. Also it is most opportunistic infection among those suffering from other co morbid conditions like carcinoma, HIV AIDS and diabetes etc. Ilaj bil ghida (Dietotherapy) is a unique approach of Unani System of Medicine through which physicians focused on nutritional status of the patient and advised diet accordingly. Donkey or Jenny milk has been known since antiquity for its cosmetic and nutritional values. Paper is about review donkey milk's specifications and qualities in context to Tuberculosis and its treatment.

**KEY WORDS:** Donkey Milk, Dietotherapy, Antitubercular treatment, Unani Medicine

#### INTRODUCTION

Tuberculosis is a communicable disease which has taken epidemic form with increasing burden worldwide, much prevalent in developing countries. This infectious disease typically affects the lungs (Pulmonary TB), but can also affect other sites (Extra Pulmonary TB). Susceptibility of disease may vary according to socioeconomic conditions and nutritional status. Also it is most opportunistic infection among those suffering from other co morbid conditions like carcinoma, HIV AIDS and diabetes etc.<sup>1,2</sup>

According to WHO among 30 high TB burden countries India is leading its share up to 27%, whereas China 14% and Russian Federation 9%. Every year an average of 130 new cases per 100,000 population (approx.10 million) fell ill globally. Death toll was reported to be 1.2million among HIV negative tubercular sufferers in 2018. Considered it to be medical emergency United Nations organized first ever meet on this deadly disease in 2018 and commitment was made to end TB epidemic by 2030.WHO take it serious medical issue and doing tired less efforts to eradicate it completely. for which many different programmes has been initiated and spending billions of dollars every year on diagnosis, treatment and care.ATT a form of multi drug therapy is provided to the patients along with some dietary recommendations and cash incentive to promote patient's nutritional status.<sup>1,2</sup>

Despite of continuous efforts, still goal is not achieved, and drug resistant tuberculosis is emerging as a new challenge in the treatment scenario.<sup>3</sup> In 2018 about half million new cases of rifampicin resistant TB.<sup>1</sup> Neurotoxicity and hepatotoxicity as side effect of ATT drugs cannot be neglected which sometimes becomes more serious issue during treatment.<sup>4-7</sup> Hence need was felt to search an eatable source with nutritional and therapeutic benefits, suitable for all age groups which may improve

nutritional status and augment therapeutic effects of ATT drugs synergistically by its curative properties.

#### CONCEPT OF LACTOTHERAPY IN UNANI SYSTEM OF MEDICINE

Ilaj bil ghida (Dietotherapy) is a unique approach of Unani System of Medicine through which physicians focused on nutritional status of the patient and advised diet accordingly. Weak people are prone to be indulged in various digestive and neuropsychiatric disorders.<sup>8</sup>

There are certain medical conditions in which overall body gets atrophied, viscera becomes weak and reduces their weight and dimensions, also digestive system gets affected and digestion is not proper, resulting more weakness and general debility. Hence they advised food according to patient profile as a part of treatment especially in chronic diseases.

Patients advised to take diet in small packages in frequent manner preferably liquid and light.<sup>8</sup>

Apart from various food elements, physicians strongly recommended milk consumption from different sources in different kinds of medical problems for which human milk, equid milk and goat milk gained their specific recognition. Human milk assumed to be best in all respect and donkey milk considered to be the next valuable.<sup>8,9</sup>

Apart from various food elements, physicians strongly recommended milk consumption from different sources in different kinds of medical problems for which human milk, equid milk and goat milk gained their specific recognition. Human milk assumed to be best in all respect and donkey milk considered to be the next valuable.<sup>8,9</sup>

According to Unani physicians, human milk is considered to be highly beneficial as protector of tabiyat and Majalli in nature.<sup>10</sup> It contains cytokines and chemokines which are responsible for beneficial effects in asthma and other allergic disorders.<sup>11, 12</sup>

Breast sucking acts as mechanical exercise, flow resistance during sucking increases lungs efficiency lung parenchyma, improves lung volume and elasticity resulting in increased lung capacity and increased airflow. Hence improved the overall mechanics of ventilation.<sup>13</sup> Immune mechanism may act by remodeling the airways and may explain the protective effect of breast feeding. Its protective immunoactive factors may reduce allergic susceptibility of lung tissues, promotes better lung growth in children. The ghiza e dawaaii qualities (Nutritional values, immunoactive factors) and suckling exercise were thought to augment healing process many folds.<sup>14, 15</sup>

That may be the reason why they strongly recommended to their sill, Zaaturriya and lung ailments patients for breast sucking directly (if possible) in order to improve lung functional capacity.

Donkey or Jenny milk has been known since antiquity for its cosmetic and nutritional values.<sup>16</sup> In Ayurveda it has been used locally in anti ageing preparations and ointments for treating eczema and psoriasis. In Unani System of Medicine it is especially recommended orally as rejuvenator, protector, nutrient and wonderful healing agent for internal organs ulceration.<sup>10,17</sup> Studies emphasized that components like minerals, vitamins, essential fatty acids, bioactive enzyme makes this milk indeed beneficial for skin, respiratory disorders, diabetes, gastric ailments and also preventive to seasonal exposure.<sup>18, 19</sup>

So donkey milk is selected for which Unani physicians paid attention and quoted its use at various places in their treatise in internal wounds or ulceration especially 'sill ' which is a clinical manifestation of pulmonary tuberculosis up to a great extent. Paper is about review donkey milk's specifications and qualities in context to Tuberculosis and its treatment.

Milk is required for healthy musculature and bony strength. The females of all mammals can produce milk which is designed to meet specific needs to its neonate. It provides essential amino acids, minerals and fatty acids to boost metabolism and hence facilitates overall growth of the body and reduces progression of degenerative bone disorders like osteoarthritis.<sup>20, 21</sup>

Besides food additionally milk is required for growing children, young adults, elderly and debilitated people. For this reason ruminant milk is consumed since the earliest domestication of livestock. Billions of liters milk is consumed every day worldwide, majority of which is cow milk. According to The Food and Agriculture Organization (FAO), 85% of all milk worldwide produced from cows. Besides cows, many kinds of livestock provide milk to human are water buffalo (11%) goat (2%), sheep (1.4%), camel (0.2%), donkeys, horse, reindeer and yak etc.<sup>22,23</sup>

### General description of good quality milk

Milk has been wonderful source of nutrition and energy for all ages. Good quality milk produces good quality blood which in turn makes quality milk in lactating animals. For procuring good quality milk Unani physicians set specific norms such as health status, diet, period of lactation and weather conditions etc.<sup>17</sup>

Hunain bin Ishaq quoted that donkey may be given some anti-inflammatory and deobstruent medicines if its milk is being provided to the patients suffering from obstructive pathology in chest, lungs or bladder, in order to get best therapeutic gains from its milk.<sup>17</sup> Milk should be tasty, easy to digest and should not coagulate in stomach.

According to them, milk should be procured from healthy animals with close proximity to human temperament like swine, sheep, cow, horse, donkey, goat, deer etc. Milk should be tasty, easily digestible and should not coagulate or accumulate in stomach.<sup>9</sup>

It should have peculiar smell of milk, slightly sweet in taste without added flavors neither sour nor salty. Animals grazing green grass produces diluted milk which is better to human beings. Goat milk is balanced in respect of water and fat contents, whereas sheep milk is fatty and most concentrated among all. Camel and horse milk are also diluted and less fatty. Donkey milk which is least fatty and most diluted among all above mentioned, also assumed that it doesn't coagulate inside the stomach if taken as fresh, hence most suitable for patients.<sup>17</sup>

### Different quotes from Unani physicians regarding milk:<sup>9,14,15,17</sup>

- "Milk increases body strength". **Rhazis (850 AD -923 AD)**
- Milk is closely related to blood in qualities and temperament. **Rhazis (850 AD -923 AD), Ibne - Baytar (1197AD - 1248AD)**
- It modifies morbid matters and facilitates easy n prompt removal from the body.
- "If a patient of diq is highly asthenic and there is excessive dryness inside the body with no more febrile illness, it is recommended to advise fresh milk. If patient is febrile or have high temperature then buttermilk can be given instead of milk". **Rhazis (850 AD -923 AD)**
- "Patients of excessive dryness and cough should consume milk and milk water accordingly". **Ibne - Hubl Baghdadi (1213 AD)**
- Milk consumption is highly beneficial for healing ulcer of lung parenchyma. **Rhazis (850 AD -923 AD)**
- According to **Faladeus**, Sil patients becomes healthy by consuming milk.
- Milk is very good for healing through its liquid content which cleanses and wash off the debris whereas its whey part gets attached to ulcer and promotes healing. **Rhazis (850 AD -923 AD)**<sup>42</sup>

**Donkey milk peculiarities:** Donkey or Jenny milk has been known since antiquity for its cosmetic and nutritional values.<sup>10</sup> For the past one and half decade research has been carried out on donkey milk to identify its biologically active components and to know about its health promoting properties.<sup>24</sup>

**Lactation period & Composition:** Pregnancy period last about one year, nearer to human being. On an average a donkey gives 500ml-1300ml milk per day for about 6-7 months, varies according to techniques of milking, reproduction and nutrition etc.<sup>25</sup>

The table shows that jenny milk has closer resemblance to breast milk as compared to cow.<sup>25</sup>

Composition of donkey's, mare's, human and cow's milk (g/100 g)				
composition	donkey	mare	human	cow
pH	7.0 – 7.2	7.18	7.0 – 7.5	6.6 – 6.8
Protein g/100g	1.5 – 1.8	1.5 – 2.8	0.9 – 1.7	3.1 – 3.8
Fat g/100g	0.3 – 1.8	0.5 – 2.0	3.5 – 4.0	3.5 – 3.9
Lactose g/100g	5.8 – 7.4	5.8 – 7.0	6.3 – 7.0	4.4 – 4.9
Total Solids (TS) g/100 g	8.8–11.7	9.3–11.6	11.7–12.9	12.5–13.0
Casein Nitrogen (CN) g/100 g	0.64–1.03	0.94–1.2	0.32–0.42	2.46–2.80
Whey protein g/100 g	0.49–0.80	0.74–0.91	0.68–0.83	0.55–0.70
NPN g/100 g	0.18–0.41	0.17–0.35	0.26–0.32	0.1–0.19
Casein Nitrogen (CN) %	47.28	50	26.06	77.23
Whey protein %	36.96	38.79	53.52	17.54
NPN %	15.76	11.21	20.42	5.23

**Close resemblance to human milk:** Donkey milk is similar to human milk in most of its qualities and contents. Lactose as a disaccharide is considered to be a primary source of energy. Lactose content of donkey milk yields to be 5.9gm% approaching human milk whereas this quantity is quite greater than that of cow milk. Hence supports unani physician's consideration of donkey milk as a best possible alternative to human milk in respect of immunoactive factors and nutritional values.<sup>25, 26</sup>

**Suitable for all age groups:** Equid milk especially DM is digestive friendly and considered to be hypoallergenic drinkable milk.<sup>27</sup> It is highly suitable and well tolerated by infants and children having cow milk protein allergy (CMPA).[28] The casein coagulum formed in the stomach is assumed to be very soft and easily digestible, hence suitable for infants, growing children and elderly population.<sup>8, 29, 30</sup> As protector, rejuvenator and joyful (farhat bakhsh) it improves body strength.<sup>10, 17</sup> It is beneficial as antioxidant and immune system regulator for healthy elderly consumers.<sup>19</sup> Effective in the treatment of arteriosclerosis.<sup>31</sup>

#### As Nutraceutical and Growth promoter

Donkey milk is popular in its whey protein dairy products as its whey protein content is 49.09% as compared to cow milk which is hardly 0.7% only. It accounts 44.3% part of total amino acid content in the form of nine essential amino acids, similar to human milk in proportion, more than cow milk.<sup>26</sup>

Taurine, a sulphur containing non proteinous amino acid which is nine times higher than cow milk, acts as essential nutrient especially for growing infants. It helps in fat digestion, development, of nerves, brain and cardiac muscles and good for vision also. Deficiency of Taurine can cause poor growth and mental retardation.<sup>26</sup>

Appropriate combination of vitamins, minerals, calcium phosphorus ratio is necessary to be maintained for better bony as well as skeletal development. Higher whey protein, lactose and vitamin (A, B1 and B2) contents make this milk superior to other conventional milks, hence it may be served as alternative food formulation and can be a wonderful source of energy.<sup>25, 29</sup>

**Food preservative:** Antimicrobial property can be serving it to be a natural food Preservative. It can be a boon as a novel food with nutritional profile. The natural preservative properties constitutes its lengthy shelf can be easily kept in dried freeze form.<sup>32-34</sup>

**Improves temperament of body:** Sill patient is a clear-cut picture of excessive dryness and general debility.<sup>8</sup> Donkey milk is moist and cold in nature hence it is highly suitable for patients suffering from hot and dry dystemperament which is a peculiar feature of patients suffering from Sill.

Sue Mizaj Yabis Meda (Dry dystemperment of stomach), one of the stubborn problem of stomach also associated with sill, patients are advised to consume DM as a best medicine for them.

**Analgesic and antipyretic activity:** As a wonderful Cleaner (majalli ) and deobstruent (Mufattah), donkey milk reduces the noxious effect of irritant humors (charpare akhlaat).It hampers morbid matters accumulation or infiltration towards susceptible or weak organ, slough out the irritant materials from the body through its detergent activity, hence reduces inflammatory conditions and speed up healing process. Helps to relieve pain from pain producing chemical mediators. (Tez w raddi type humors).<sup>17</sup>

**Antimicrobial property:** Distinctive value of Dm is antimicrobial specialty.<sup>32-34</sup> Lysozyme play an important role in intestinal immune response, Gram Positive are more sensitive to Lysozyme than Gram negative bacteria.<sup>34</sup> It inhibit the growth especially for staphylococcus aureus, listeria monocytogenes and campylobacter jejuni.<sup>27</sup>

**Antioxidant:** It is reported that it is beneficial in scavenging both hydroxyl radical and superoxide anion radicals, more than cow milk.<sup>26, 35</sup>

Moreover yoghurt prepared with donkey milk added with two probiotic strains shows the resulted product is rich of higher antioxidant activity.<sup>35</sup>

**Immunomodulator:** Immunoglobulins of donkey milk show high content comparative to human and bovine counterpart.<sup>36</sup> It is an excellent source of lysozyme, the key enzyme that boosts body immunity. Lysozyme play an important role in intestinal immune response, Gram Positive are more sensitive to Lysozyme than Gram negative bacteria.<sup>34</sup> The study carried out on bald mice with donkey milk added with lactobacillus rhamnosus ZDY114 to know its immunomodulatory activity showed that the combination exhibited commendable increase in splenic proliferation, carbon granule engulfing ability and natural killer cell activity. That means jenny milk has potential to enhance specific immune reactions.<sup>37</sup> Enzymes such as Lactoperoxidase (LP) and oxidoreductase and Lactoferrin which is iron binding, multifunctional glycoprotein also accounts its antimicrobial, antiviral, immunomodulatory, anti-tumor properties.<sup>38-40</sup> Moreover, Taurine which is nine times higher than cow milk.is also evident to enhances body immunity and fight muscle fatigue.<sup>26</sup>

#### THERAPEUTIC BENEFITS OF DONKEY MILK

The milk has high potential to remove morbid matters from the body (Tanqiyah), especially purulent secretions, augment healing process as it is a wonderful mumbit e laham agent hence considered to be a wonderful medicine.<sup>8</sup> It gets readily absorbed

through intestines and gets assimilated with blood and transports its protective agents (proteins, lysozymes) towards the target organs where lesions are situated i.e. Lungs, heart, intestines, uterus, urinary bladder, urethra etc and promotes healing. Beneficial in ailments pertaining to cardiovascular, respiratory and digestive and genitourinary systems.

**Effects on GIT:** As a protector of tabiyat and deobstruent, it improves intestinal functions, increases motility, removes cell debris and morbid matter via intestines hence helpful in alleviating obstructive, spasmodic, inflammatory and ulcerative pathologies of alimentary canal, so beneficial for ascites, anaemia, dysentery, dusantariya etc. It reduces toxic effects of drugs.<sup>17</sup> Donkey milk helps to improve the quality of blood and improve anaemia (tangi dam).<sup>10</sup> According to Dioscorides, gargle with this milk strengthens gums and teeth.<sup>17</sup>

**Endocrine system:** Low-GI indexed (>50) food is required for diabetic patients, so donkey milk is appropriate for diabetic patients as G I index of lactose, maltose and glucose contents is 46, 43.8% and 46% respectively. Taurine which is a non-protein and sulphur containing amino acid found in DM is considered as beneficial in improving endocrine system, regulates body metabolism and help fight fatigue.<sup>26</sup>

**Haematopoetic:** Being a nutritional source and stimulant, it improves the quality of blood and improves anaemia (tangi dum).<sup>8</sup>

**Genitourinary ailments:** Equine milk is diuretic in nature, relieves dysuria and helpful in healing ulcers of urinary tract especially bladder and urethra. Tabri quoted that enema of this milk can relieve uterine wounds.<sup>17</sup>

**Cardiovascular system:** Donkey milk was thought to be beneficial for all types of cardiothoracic ailments. Helps alleviating hot tempered heart ailments.<sup>17, 26, 35</sup> That may be attributed to its protector, deobstruent and majalli qualities.

Scientific studies suggested that this milk is low in fat mainly in the form of unsaturated fatty acids (MUFA and PUFA). The percentage of unsaturated fatty acid to total fatty acid is 49.5%, (Human milk 45.2%, Cow milk 32.0%).

A beverage prepared by donkey milk added with sunflower oil exhibits more favorable lipid quality indexes (atherogenicity and thrombogenicity index) than Donkey milk alone as it is rich in folic acid and higher level of polyunsaturated acid (PUFA) contents. It is also noticed that this is effective in the treatment of arteriosclerosis proteinoeous and highly beneficial in patients suffering from obesity, cerebrovascular and cardiovascular disorders.<sup>40, 41</sup>

**Respiratory system:** DM is highly beneficial for all types of lung ailments. Especially sill type of lung ulcer, febrile illness, cough, hemoptysis, weakness etc.<sup>18</sup> Evident from various studies that enzymes such as Lactoperoxidase (LP) and oxidoreductase and Lactoferrin which is iron binding, multifunctional glycoprotein also accounts its antimicrobial, antiviral, immunomodulatory, anti-tumor properties.<sup>38-40</sup>

## CONCEPT OF SILL AND PULMONARY TUBERCULOSIS

There is no reference of tuberculosis mentioned as such in classical Unani texts, but physicians described the term Humma e Diq which is applicable to a typical type of low grade fever commonly seen as a constitutional symptoms in tuberculous

patients whereas the clinical picture depicted by them in sill is closely correlated with pulmonary tuberculosis.

Galen (129 – 200 AD) described sill as a chronic febrile illness in which lungs get ulcerated directly or by infiltration of some irritant fluids from their surrounding structures or from brains.

The condition is almost always associated with low grade fever known as Humma e Diq, this abnormal heat though mild in nature, slowly destroys body fluids, as a result affected persons become lean, thin and dry. Vital organs affected by predominance of excessive heat and dryness may suffer from severe sort of weakness, unconsciousness etc. For such cases best diet is DM and barley water. The temperature rises after food intake and during evening hours.<sup>15</sup> There is common clinical haemoptysis seen among pulmonary tuberculous patients.<sup>14</sup> According to Razi, sill can come into effect as complication of other diseases Nafasuddum (haemoptysis.), Zaatul janab (pleurisy), zaaturriya (pneumonia), chronic rhinitis etc. Line of treatment in such cases is to remove pus from the body and augment healing process, so for this reason Dm is strongly recommended by many Unani philosophers. For such cases best diet is DM and barley water.<sup>8</sup> Donkey milk was also advised prophylactically in initial phase of Zaaturriya as it was assumed that it may be transformed into Sill.<sup>14</sup>

Razi quoted in his book that "I have heard about a patient who was suffering from chronic pulmonary ulceration, consumed fresh donkey milk daily and became healthy just after 20 days. According to Unani physicians, human milk is considered to be highly beneficial as protector of tabiyat and Majalli in nature.<sup>17</sup> It contains cytokines and chemokines which are responsible for beneficial effects in asthma and other allergic disorders.<sup>11, 12</sup> Breast sucking acts as mechanical exercise, flow resistance during sucking increases lungs efficiency lung parenchyma, improves lung volume and elasticity resulting in increased lung capacity and increased airflow. Hence improved the overall mechanics of ventilation.<sup>12</sup> Immune mechanism may act by remodelling the airways and may explain the protective effect of breast feeding. Its protective immunoactive factors may reduce allergic susceptibility of lung tissues, promotes better lung growth in children. The ghiza e dawaaii qualities (Nutritional values, immunoactive factors) and suckling exercise were thought to augment healing process many folds.<sup>14, 15</sup> That may be the reason why they strongly recommended their sill, Zaaturriya and lung ailments patients for breast sucking directly (if possible) in order to improve lung functional capacity.

## THERAPEUTIC DOSAGE

It may vary from 100 ml to 250 ml according to need and patient profile either separately or with some food materials like rice. It may be flavoured with shaker (Brown sugar), honey and salt which makes it tasty and easily digestible with no extra burden on stomach.<sup>8, 9</sup>

They prohibited milk intake in high grade fever or in initial phase of disease. Special attention is to be paid in highly asthenic and cachexic patients as they may not tolerate and may involve in diarrhea.<sup>14</sup> In case of highly debilitated patients, soupy preparations, massage with milk and fat and may be beneficial.<sup>9</sup> For Sill patients start from 70 ml and increase quantity slowly up to 1 litre along with appropriate drugs.

It is noticed that lactoperoxidase (LP) and oxidoreductase are known to be inactivated by high temperature.<sup>40, 41</sup> hence significant nutritional interest in raw fresh milk, lactoferrin and lysozyme along with Lactoperoxidase (LP) enhances natural

activity of this milk that supports the idea why Unani physicians recommended to consume milk in morning hours just after milking as a fresh.<sup>14, 15, 34</sup>

## DISCUSSION

TB is among the top ten cause of deaths worldwide, about quarter of world's population is infected with this problem TB epidemic will be continued to be public health threat and the target of TB free World up to 2035 cannot met without continuous efforts, intensified research and development. The infection can be cured and onward transmission may be curtailed with timely diagnosis and treatment. The number of TB cases can be driven down by reducing the prevalence of health related risk factors eg. undernutrition, Diabetes, HIV infection and improvement in socioeconomic conditions of the patients.

To meet the challenge of making world TB free up to 2035, donkey milk may prove to be a better nutraceutical, immunomodulator and rejuvenating food source packed with anti-inflammatory omega 3 fatty acids, calcium, phospholipids, probiotics, vitamins A, C and E etc. Milk is considered as best mammalian alternative to human milk especially in infants with cow milk intolerance. Low fat and cholesterol and high essential fatty acids make it suitable for elderly, cardiovascular, obesity and gallstones problems etc. The qualities being digestible, nutritive, antioxidant and immunomodulator of this milk make it a versatile, unique source of energy and superior among commercially available mammalian milk.

## CONCLUSION

Donkey milk is a natural antimicrobial with a high content of lysozymes and lactoferrin. It has emerged as a beauty elixir rich in variety of minerals, vitamins, antioxidants which may hamper unwanted side effects of ATT drugs and better aid to fight against increasing Incidence of drug resistant tuberculosis. Hence it may become best possible adjuvant to conventional antitubercular treatment regime. A further clinical study is imperative to confirm this review.

## SUGGESTIONS

Donkey milk is not easily available, 20-30 ml milk cost ranges to 50-100 rupees approximately 1000 rupees per liter which is not affordable in current scenario. This can be solved by spreading awareness among people about this milk. Nowadays it is mostly used in manufacture of creams and soaps, but later people may come to know its magical curative properties and hence may get benefitted with this amazing quality milk.

Govt. may implement some schemes to promote donkey's rearing among people in terms of professional gain. More NGOs may come forward apart from one or two to promote donkey rearing and domestication among farmers and people to increase their number, breeds, to get milk on larger scale and make this milk accessible and affordable to all.

For infants and children suffering from tuberculous infections, donkey milk can be given in bottles which may be designed in such a manner to artificial increase of airflow resistance as it is during breast suckling, so that the mechanical benefits in lung function may resumed with artificial bottle feeding and breast milk therapeutic gains can be acquired as donkey milk is assumed to be similar to breast milk up to a great extent.

Milk can be taken as liquid or dried lyophilized powder can be prepared for easy handling in small packets and can be provided to the patient along with ATT drugs.

## REFERENCES

1. Global Tuberculosis Report. Geneva: World Health Organization; 2020. Report No.: ISBN 978-92-4-001313-1 (electronic version).
2. Treatment of Tuberculosis: Guidelines for National Programmes. Geneva: World Health Organization; 2003
3. Guidelines for the programmatic management of drug-resistant tuberculosis. Geneva: World Health Organization; 2008. Report No.: ISBN 978 92 4 154758 1.
4. Thwaites G, Fisher M, Hemingway C, Scott G, Solmon T, Innes J. British Infection Society guidelines for the diagnosis and treatment of tuberculosis of the central nervous system in adults and children. *Journal of Infection*. 2009 September; 59(3).
5. Tajender V, Saluja J. INH induced status epilepticus: response to pyridoxine. *Indian Chest Dis Allied Sci*. 2006;48(3):205-6.
6. Tai WP, Yue H, Hu PJ. Coma caused by isoniazid poisoning in a patient treated with pyridoxine and hemodialysis. *Adv Ther*. 2008;25(10):1085-8.
7. Forget EJ, Menzies D. Adverse reactions to firstline antituberculosis drugs. *Expert Opin Drug Saf*. 2006;5(2):231-49.
8. Razi AMBZ. *Kitab-al-Haawi Vol 6*, New Delhi: Central Council for Research in Unani Medicine; pp.217-18, 224-25, 227-28, 230.
9. Razi AMBZ. *Kitab-al-Mansoori* New Delhi: Central Council for Research in Unani Medicine; 1991; pp.407.
10. Munshi GN. *Makhzan al Mufradat wa Murakbat*, Khwas al Adwia, New Delhi: Central Council for Research in Unani Medicine; 2007; pp.203, 211, 304.
11. Hawkes JS, Bryan DL, James MJ, et al. Cytokines (IL-1beta, IL-6, TNF-alpha, TGF-beta1, and TGF-beta2) and prostaglandin E2 in human milk during the first three months postpartum. *Pediatr Res* 1999;46:194-9
12. Oddy WH, Halonen M, Martinez FD, et al. TGF-beta in human milk is associated with wheeze in infancy. *J Allergy Clin Immunol* 2003;112:723-8.
13. I U Ogbuanu, W Karmaus, SH Arshad, RJ Kurukulaaratchy, S Ewart. Effect of breastfeeding duration on lung function at age 10 years: a prospective birth cohort study. Author manuscript. *Thrax-2009 Jan*;64(1):62-66.
14. Razi AMBZ. *Kitab-al-Haawi Vol 4*, New Delhi: Central Council for Research in Unani Medicine; pp.85, 88, 90-94, 96, 99, 100-103, 123.
15. Baghdadi IH. *Kitab-al-Mukhtarat Fi-al-tibb*, Vol-3 New Delhi: Central Council for Research in Unani Medicine: YNM: pp. 163, 169, 177-78.
16. Uniackle-Lowe, T., 2011. Studies on equine milk and comparative studies on equine and bovine milk systems. PhD Thesis, University College Cork.
17. Baytar 1. *Kitab-ul-Jame-ul-Mufradat-al-advia wal Aghzia* volume 4, New Delhi: Central Council for Research in Unani Medicine; pp.223-27, 233-34.
18. Lu DL, Zhang DF, Liu PL, Dong ML. Chemical composition and nutritive value in donkey milk. *Xin jiang Agricultural Sciences*. 2006;43(4):335-340. [Google Scholar]
19. Zhang XY. Composition, physiochemical properties, nitrogen fraction distribution, and amino acid profile of donkey milk. *Journal of Dairy Science*. 2007;90(4):1635-1643. doi: 10.3168/jds.2006-600. [PubMed] [CrossRef] [Google Scholar]

20. Haug A, Hostmark AT, Harstad OM. Bovine milk in human nutrition: a review. *Lipids Health Dis* 2007; 6:25.]
21. Bing Lu, Jeffrey B. Driban, Jeffrey Duryea, Timothy Mcalindon, Kate I. Lapane, Andcharles B. Eaton. ' Milk Consumption and Progression of MedialTibiofemoral Knee Osteoarthritis: Data from the Osteoarthritis Initiative'; *Arthritis Care & Research* Vol. 66, No. 6, June 2014, pp 802-809.
22. Jarvinen KM, Chatchatee P. Mammalian milk allergy: clinical suspicion, cross reactivities and diagnosis. *Curr Opin Allergy Cl in Immunol.* 2009; 9:251-258.
23. Gerosa and Skoet (2012). "Milk availability - Trends in production and demand and medium-term outlook" (PDF). Food and Agriculture Organization, United Nations. Archived (PDF) from the original on September 6, 2012. Retrieved August 1, 2012.]
24. Cavallarin L, Giribaldi M, de los Dolores Soto- Del RioM, Valle E, Barbarino G, Gennero MS, Civera T- A survey on the milk chemical and microbiological quality in dairy Donkey milk Proteins: Digestibility and Nutritional Significance donkey farms located in North Western Italy. *Food Control.*2015;50:230-235.
25. Guo, H.Y; Pang, K; Zhang, X. Y; Zhao, L; Chen, S.W; Dong, M.L; Ren, F.Z (2007). "Composition. Physiochemical Properties, Nitrogen Fraction Distribution, and Amino Acid Profile of Donkey Milk". *Journal of Dairy Science.*90(4): 1635-43.]
26. Ling Li,12 Xinfeng Liu, and Hong Guo, The nutritional ingredients and antioxidant activity of donkey milk and donkey milk powder, *Food Sci Biotechnol.* 2018 Apr; 27(2): 393-400.
27. Fratini F, Turchi B, Pedonese F, Pizzurro F, Ragaglini P, Torracca B, Tozzi B, Galiero A, Nuvoloni R. Does the addition of donkey milk inhibit the replication of pathogen microorganisms in goat milk at refrigerated condition? *Dairy Sci Technol.* 2015; 96:1-8. DOI: 10.1007/s13594-015-0249-y
28. Lara-Villoslad F, Olivares M, Xaus J. The balance between caseins and whey proteins in cow 's milk determines its allergenicity. *J Dairy Sci.* 2005; 1654-1660.
29. 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.
30. Solaroli G, Pagliarini E, Peri C. Composition and nutritional quality of mare's milk. *Ital J Food Sci.* 1993; 5:3-10.
31. Carroccio A, Cavataio F, Montalto G, D'Amico D, Alabrese L, Iacono G. Intolerance to hydrolysed cow's milk proteins in infants: clinical characteristics and dietary treatment. *Clin. Exp. Allergy.* 2000;30(11):1597-1603. doi: 10.1046/j.1365-2222.2000.00925.x. [PubMed] [Cross Ref] [Google Scholar]
32. Zhang X, Zhao L, Jiang L, Dong M, Ren F. The antimicrobial activity of donkey milk and its microflora changes during storage. *Food Control.* 2008; 19: 1191-1195.
33. Tidona F, Sekse C, Criscione A, Jacobsen M, Bordonaro S, Marletta D, Vegarud GE. Antimicrobial effect of donkeys' milk digested in vitro with human gastrointestinal enzymes. *Int Dairy J.*2011;21:158-165.
34. Saric L, Saric BM, Mandic AI, Torbica AM, Tomic JM, Cvetkovic DD, Okanovic DG. Antibacterial properties of domestic Balkan donkeys' milk. *Int Dairy J.* 2012;25: 142-146.
35. Perna A, Intaglietta I, Simonetti A, Gambacorta E. Donkey milk for manufacture of novel functional fermented beverages. *J Food Sci.* 2015; 80:352-359. DOI: 10.1111/1750-3841.12862
36. Uniacke-Lowe T, Huppertz T, Fox PF. Equine milk proteins: chemistry, structure and nutritional significance. *Int Dairy J.* 2010; 20:609-629. DOI: 10.1016/j. idairyj. 2010.02.007
37. Immunomodulatory activities of *Lactobacillus rhamnosus* ZDY114 and donkey milk in BALB/c. mice. *International Dairy Journal.* 2014; 34 (2): 263-266.
38. Tomita M, Wakabayashi H, Shin K, Yamauchi K, Yaeshima T, Iwatsuki K. Twenty-five years of research on bovine lactoferrin applications. *Biochimie.* 2009; 91:52-263-266.] 57. DOI: 10.1016/j. biochi. 2008.05.021
39. Simos Y, Metsios A, Verginadis I, D' Alessandro AG, Loiudice P, Jirillo E, Charalampidis P, Kouimanis V, Boulaka A, Martemucci G, Karkabounas S. Antioxidant and antiplatelet properties of milk from goat, donkey and cow: an in vitro, ex vivo and in vivo study. *Int Dairy J.* 2011; 21:901-906. DOI: 10.1016/j. idairyj. 2011.05.007
40. Mariani P. Donkey milk nutraceutical characteristics: a biochemical evaluation of nutritious and clinical properties [PhD thesis]. Camerino: University of Camerino, Italy; 2010. Available at: <http://cameprints.unicam.it/284>. Accessed 1 April 2015.
41. Tidona F, Charfi I, Povo M, Pelizzola V, Carminati D, Contarini G, Giraffa G. Fermented beverage emulsion based on donkey milk with sunflower oil. *Int J Food Sci Technol.* 2015; 50: 2644-2652. DOI: 10.1111/ijfs. 12936
42. Changizi Ashtiyani S, Cyrus A. Rhazes, a genius physician in diagnosis and treatment of kidney calculi in medical history. *Iran J Kidney Dis.* 2010 Apr;4(2):106-10. PMID: 20404418.

**Cite this article as:**

Mohmmmd Abdullha, Abrar Mohd Khan, Mohammad Asif Qurashi and Syed Abshar Ali. A review on donkey milk as adjuvant dietotherapy with anti-tuberculosis treatment. *J Biol Sci Opin* 2024;12(3): 32-37. <http://dx.doi.org/10.7897/2321-6328.12393>

Source of support: Nil; Conflict of interest: None Declared

Disclaimer: JBSO is solely owned by Moksha Publishing House - A non-profit publishing house, dedicated to publishing quality research, while every effort has been taken to verify the accuracy of the contents published in our Journal. JBSO cannot accept any responsibility or liability for the site content and articles published. The views expressed in articles by our contributing authors are not necessarily those of JBSO editor or editorial board members.