

## Camel Milk; An Especial Remedy for Treatment of Autism

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### Abstract

Autism is a neurodevelopment disorder and autoimmune disease that is linked with gastrointestinal disease, mental retardation, impairment of behavioral and social communication. Oxidative stress has a key role in autism. Oxidative stress occurs when reactive oxygen species amounts exceed the antioxidant activity of cells. It acts as a mediator in brain injury, neurodegenerative diseases and lead to autism. Camel milk has potential therapeutic effects in autism. The consumption of camel milk in children suffering from autism cause to reduce of autism symptoms and improve motor skills, language and cognition. Camel milk contains high minerals like iron, copper, zinc, magnesium, and high vitamin C which considered as strong antioxidant against free radicals. Also due to the smaller size of immunoglobulin of camel milk, it can recover immune system of autistic cases. Therefore, findings suggest that camel milk play an important role in decreasing oxidative stress by alteration and increasing of antioxidant enzymes; like glutathione peroxidase, superoxide dismutase, myeloperoxidase and nonenzymatic antioxidants, improve autistic behaviors.

**Keywords:** Autism; Antioxidant; Brain; Camel Milk; Oxidative Stress

### Introduction

Autism spectrum disorder (ASD) is a severe neurodevelopment malfunctions that can be realized at 3 years of age, and are characterized by impairments in communication and social interaction. In addition to behavioral impairment, autism is associated with high prevalence of gastrointestinal disease and mental retardation [7]. It is an autoimmune disease, which reactions in the intestines begin with diarrhea and effect on appetite [21].

The increased production of reactive oxygen species and oxidative stress may result in the injury and reduction of brain cell number, apoptosis and autism diseases [20]. Thus, the control of reactive oxygen production is necessary for cell function and they should be neutralized by antioxidant enzymes including superoxide dismutase, catalase and glutathione peroxidase [4].

Camel milk has therapeutic effects in many diseases such as food allergy, diabetes mellitus, hepatitis B, autism, and other autoimmune diseases [26]. Autistic children drinking camel milk have had amazing improvements in their behavior [4]. Camel milk decrease oxidative stress by alteration of antioxidant enzymes and nonenzymatic antioxidant molecules, therefore improve autistic behaviors and symptoms. The consumption of camel milk in autistic cases improved motor skills, language and social communication [17].

Researchers reported use of camel milk possibly leads to recovering immune system, due to the immunoglobulins of camel milk; therefore brain damage can be prevented when camel milk is fed at

an early age. Camel milk immunoglobulin's are smaller in size, and penetrate to tissues and consequently they are more active against antigens and more available for combating autoimmune diseases [3].

### Some researches about camel milk on autism

In one study, the effect of camel milk consumption on oxidative stress in ASD cases were investigated. Sixty subjects (2–12 years old) with ASD, especially those with known allergies, divided into 3 groups. Groups received 500 ml/day raw camel milk, boiled camel milk and cow milk. Results showed glutathione peroxidase, superoxide dismutase, and myeloperoxidase significantly increased 2 weeks after camel milk consumption. There was a significant elevation of myeloperoxidase in the groups of raw and boiled camel milk but not in cow milk group and control. Actually, children fed on camel milk, showed less oxidative stress at the end of two weeks, antioxidant activity increased and improvement in behavioral and cognitive tests observed [2,4].

In other study on autistic kid. that diagnosed at 3 years of age, camel milk was used at 9 years of age. At first, half cup of freezed raw camel milk consumed daily, and then regular consumption of camel milk continued that was associated with improvements in autism symptoms for 6 consecutive years. Also by daily consuming 4 oz of camel milk, rapid improvement in behavior and motor skills observed. Then by increasing the camel milk to 8 oz, pragmatic language and vocabulary skills were improved and other academic skills were above average. Therefore in this case, camel milk was important exclusively with no apparent loss of health [1].

The results of others [22] showed the effective use of camel milk against autism. Autism symptoms of a 4-year-old girl disappeared, after 40 days of drinking camel milk. Also a 15-year-old boy was autistic cured after 30-day camel milk consumption. Autistic cases [21-year-olds) that consumed camel milk for two weeks were observed to be quieter and less self-destructive. Therefore, in all these studies, camel milk significantly improved symptoms of autism severity.

The researchers [6] reported use of camel milk in autism condition significantly improves the situation and behavior of these people even after 2 weeks of camel milk consumption. The health effects were attributed to IgG antibodies and high antioxidant capacity of camel milk because of high vitamin C and minerals. Camel milk can improve social cognition and communication, and ability of speech and language in autistic children [6].

Recently, pretreatment with camel milk showed protective effects against convulsions in induced seizure mice and decreased mortality rate. This anticonvulsive effect of camel milk may be attributed to its GABAergic and glycinergic stimulatory activities as well as its antioxidant activity that can intensify antiepileptic activity [13].

It is reported that the camel milk caused to reduce oxidative stress and improvement of the behavior of autistic children [4]. Also, the autistic children after the use of camel milk have a better social condition and reduction in hyperactivity and increased regular bowel movements [23].

Other study done by El-Said, *et al.* [9] on diabetes New Zealand rabbits that received camel milk. That camel milk reduced the oxidative stress which is often accompanied with diabetes mellitus by proper alterations of antioxidant system.

### Mechanism of effect of camel milk on autism

Oxidative stress and damages occur when antioxidant defense mechanisms can't effectively remove reactive oxygen species [20]. Increased oxidative stress might contribute to disturbances of behavioral, sleep and gastrointestinal in autistic children [16].

Low level of antioxidant enzymes increase oxidative stress due to free radicals has an important role in the autism etiology. Moreover, increased oxidative stress in autistic cases leads to a decrease in the levels of antioxidants like glutathione and vitamin C [8], which leads to impairment of metabolic pathways and may contribute to the developmental delays in autism; this could be improved by micronutrient supplementation [27].

The studies showed significant increase of glutathione after camel milk consumption; due to the antioxidant nutrients of camel milk. Magnesium of camel milk reduces oxidative stress and enhances vitamins E and C absorption [5], whereas zinc increases total glutathione, glutathione peroxidase, and superoxide dismutase and catalase level. Also, vitamin E enhances glutathione levels [14]. High levels of Mg, Zn and vitamin E in camel milk might help to in-

crease glutathione and enzymes production that can decrease the oxidative stress in autistic subjects.

Superoxide dismutase as antioxidant enzyme and primary defense prevents further generation of free radicals. Insufficient capacity of superoxide dismutase to metabolize free radicals the may lead to toxicity [5]. Studies reported significant decrease of superoxide dismutase in autistic children due to the impairment of the defense mechanism against oxidative stress. Copper deficiency reduces superoxide dismutase [14], and zinc deficiency decreases superoxide dismutase, glutathione peroxidase, total glutathione, and vitamin E [18]. Superoxide dismutase level was significantly increased after camel milk consumption; this could be attributed to the high contents of zinc, copper, magnesium, and presence of vitamin E in camel milk [4].

Myeloperoxidase is a indicator of oxidative stress and inflammation that is responsible for antimicrobial activity against a wide range of organisms [12]. Autistic children with severe gastrointestinal disease have low levels of myeloperoxidase, which is directly linked with gastrointestinal pathology [11]. A significant increase in the plasma myeloperoxidase amount reported after camel milk consumption. Myeloperoxidase and superoxide dismutase work synergistically to protect the cell contents against oxidizing activity by free radicals [11].

These nutrients in camel milk enhance absorption of antioxidant vitamins, and activate antioxidant enzymes and detoxification system and reduce the oxidative stress. Studies showed increasing of glutathione, superoxide dismutase and myeloperoxidase by raw camel milk consumption was accompanied by a significant improvement in the behavior of the autistic children after two weeks of consumption [4].

It is reported that camel milk contains high minerals like sodium, potassium, iron, copper, zinc, magnesium and high vitamin C level which considered as strong antioxidants against free radicals [26].

Decreasing oxidative stress and treatment of autism by camel milk could contribute to high levels of antioxidant like vitamins C, A, and E and also antioxidant minerals such as magnesium and zinc, where are essential for glutathione synthesis, antioxidant enzymes activities and antioxidant vitamins absorption [4].

Another possibility is that camel milk can treat gastrointestinal problems, in ASD subjects, due to camel milk containing inflammation-inhibiting and hypoallergenic properties, also its smaller size antibodies which are similar to human antibodies [24,28], and thus improve some autistic behaviors.

Camel milk is casein and gluten free therefore it improves autistic clinical symptoms and behavior [26], possibly by reducing effects of excess central opioid [11].

Also the probable improvement of gastrointestinal problems due to the deprivation of camel milk from  $\beta$ -lactoglobulin and

$\beta$ -casein that are the major causes for food allergy and gastrointestinal disease in autistic subjects [19]. Lower content of  $\beta$ -casein, lack of  $\beta$ -lactoglobulin and presence of protective protein make camel milk suitable for maintain immune system and brain development [10].

Short neuroactive peptides, such as  $\beta$ -casomorphins are derived from incomplete metabolize of casein in the intestine that  $\beta$ -casomorphin has been considered as a risk factor for autism [25]. Because camel milk does not contain the two caseins, therefore cannot lead to the autism symptoms by drinking camel milk in compared to cow milk [12].

## Conclusion

Camel milk contains high minerals like sodium, potassium, iron, copper, zinc and magnesium and high vitamin C level which considered as strong antioxidant against free radicals. In conclusion, the role of camel milk in decreasing oxidative stress and treatment of ASD is because of high level of antioxidant vitamins and minerals. Camel milk could play an important role in decreasing oxidative stress by alteration of antioxidant enzymes and nonenzymatic antioxidant and improvement of autistic behavior. But it needs to do more studies about period and dosage of camel milk consumption on oxidative stress and hence the treatment of ASD.

Camel milk consumption cause significant improvement in the clinical symptoms in children with autism that patients became quieter and less destructive and showed better emotional expression and communication.

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