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Nutrition And Gut Health In Autism: An *Ayurvedic* Perspective

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ABSTRACT:

Introduction: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and interaction, presence of repetitive and restricted pattern of behaviours, interests and activities typically manifesting before the age of three years. According to centers for Disease Control and Prevention (CDC) about 1 in 36 children has been identified with ASD and it is nearly 4 times more common among boys than in girls. The exact cause of ASD remains unclear; however, dysbiosis in gut microbiota and altered intestinal permeability are increasingly implicated in its pathophysiology. Nutritional approaches and gut health interventions have gained attention for their potential to mitigate behavioural and gastrointestinal symptoms in autism. **Aim:** To explore the relationship between nutrition, gut health and autism from an *Ayurvedic* perspective. **Objectives:** 1.To study *Ayurvedic* principles related to digestion and autism. 2. To identify Ayurvedic dietary and herbal recommendations for gut health and autism. **Materials and Methods:** This review analysed *Ayurvedic* principles and contemporary evidence on gut health and nutrition in ASD. *Ayurvedic* texts were examined for insights which emphasizes the interconnection of gut health and mental well-being through the concepts of *Agni* and *Manas* while recent studies on dietary interventions were evaluated for their relevance and alignment with Ayurvedic practices. **Results:** Nutritional strategies such as casein free diets, ketogenic diet, probiotics were found to complement *Ayurvedic* principles and demonstrate potential in improving both behavioural and gastro intestinal symptoms in ASD children. **Discussion:** This review highlights the potential of *Ayurvedic* nutrition and gut health interventions in managing Autism as it helps in restoring balance in the digestive system and mitigate behavioural and gastro intestinal symptoms which can help improve the quality of life of children with autism.

Keywords: Autism, Nutrition, Gut Health, *Agni*, *Manas*.

INTRODUCTION:

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and interaction and the presence of repetitive, restricted pattern of behaviours, interests and activities[1]. It typically manifests in the early developmental period, usually before 3 years of age and significantly impacts the child's overall functioning. The real cause of neurodevelopmental disorders associated with ASD are not clear. However, it has been found that a majority of children with ASD display gastrointestinal symptoms[2]. Although the precise reasons behind these gastrointestinal issues are not fully understood, one of the proposed mechanisms is dysbiosis. This disruption in the microbial homoeostasis often referred to as dysbiosis plays a critical role in the pathophysiology of ASD. Furthermore, there is an alteration of intestinal permeability referred to as "leaky gut" in autistic patients due to altered gut microbiota or dysbiosis that results in the production and spread of a potent pro inflammatory endotoxin, namely lipopolysaccharide (LPS). This molecule can modulates CNS by using the activity of areas like amygdala that control emotions and behaviour. It also results in the inflammatory cytokines production from the immune cells that can alter the normal brain physiology and can modulate neuropeptide synthesis. Due to these mechanisms, nutrition-related factors have been hypothesized to play a causal role in the aetiology of ASD and its symptoms. *Ayurvedic* literature also emphasizes a strong interconnection between gut health and mental well-being through the concepts of *Agni* and *Manas*, suggesting that disturbances in *Agni* can adversely affect *Manas* and vice versa[3]. This review highlights the interrelationship between gut health and autism, underlining the pivotal role of gastrointestinal integrity in the management of ASD.

GUT MICROBIOTA[4]:

Gut microbiome is comprised of microorganisms such as bacteria, fungi, viruses, protozoa that are distributed throughout the entire GI tract. The enteric nervous system is often referred to as the Second Brain. The microbiota gut-brain-axis describes the bidirectional physiological connection to exchange information between the microbiota, the gut and the brain. The mechanism by which gut bacteria communicate with the brain include the secretion of neurotransmitters, neuromodulators and pro inflammatory cytokines; engaging the enteric nervous system and vagus nerve; and producing neuro active metabolites.

FACTORS AFFECTING GUT MICROBIOTA[5]:

Delivery pattern:

Microbial intestinal colonization process begins in utero by microbiota in the amniotic fluid and placenta. Newborns delivered vaginally have primary gut microbiota dominated by *Lactobacillus* and *Prevotella* derived from the mother's vaginal microbiota, while those born via caesarean delivery derive their gut microbiota from the skin, leading to dominance of *Streptococcus*, *Corynebacterium*, and *Propionibacterium*. These primary microbiota evolve over time to become more diverse and relatively stable. At the age of 3 years, they become similar to an adult's gut microbiota.

Diet:

After birth, the first effect on the gut microbiota is the infant diet (breast or formula milk). The composition of milk affect on shaping the early gut microbiota. In breast feeding infants, the species that dominate the gut microbiota are *Lactobacillus* and *Bifidobacterium*. The primary microbiota acquired during infancy may play

an important role in initial immunity during the growth of babies. For this reason, the composition of primary microbiota during this period is very important to protect babies from diseases related to poor immunity.

Medications:

The use of antibiotics destroys both pathological and beneficial microbes indiscriminately, allowing loss of gut microbiota or the so-called dysbiosis and growth of unwanted microbes. Antibiotics disrupt the competitive exclusion machinery, a basic property by which microbiota eliminate pathological microbes .

Stress:

Stress can affect health through its impact on gut bacteria. Both chronic and acute stressors can shift the gut bacteria in multiple regions and habitats both the inside (lumen) and border (mucosal lining) of the gut. Stress and depression can increase gut barrier permeability. A 'leaky gut,' allows bacteria to seep into circulation, producing an inflammatory response.

Sleep:

Abnormal sleep patterns and duration has been demonstrated to affect the composition, diversity and function of the gut microbiota through the brain-gut-microbiota axis. Sleep is related to the dynamic changes of neuropeptides in the brain. Neurotransmitters such as serotonin, γ-aminobutyric acid (GABA), norepinephrine, dopamine and glutamate have waking-promoting functions.

Environmental factors:

The most common types of environmental pollutants are heavy metals, persistent organic pollutants, food additives, and pesticides. Detecting and controlling these pollutants is crucial for maintaining good health due to their toxic effects on living organisms.

Exercise:

Exercise has been shown to regulate the gut microbiota through various mechanisms. These include promoting the secretion of neurotransmitters and hormones, increasing intestinal transit, reducing contact between pathogens and the gastrointestinal mucus layer, and releasing cytokines.

AUTISM AND GUT HEALTH:

1. **Gastrointestinal manifestations in ASD[6]:**

ASD patients with gastrointestinal symptoms were found to have more anxiety problems and other somatic complaints in addition to less social interaction in comparison to ASD patients without GI problems. Children with ASD are up to five times more likely to develop feeding problems such as food selectivity, food refusal and poor oral intake than neuro developmentally normal children. Further, constipation, diarrhoea and abdominal pain are also reported most commonly. Additionally, GI problems in autistic children were reported to lead more tantrums, aggressive behaviour and sleep disturbances, further worsening the behaviour compared to autistic individuals without GI symptoms.

2. **Leaky gut and neuroinflammation[7]:**

Disruption of the gut epithelial barrier which is physiologically involved in controlling the transit of molecules from the GI tract by tight junctions can lead to altered gut permeability. The microbiota and its metabolites are crucial in maintaining epithelial barrier integrity; therefore, dysbiosis in ASD patients may alter gut permeability. This condition, called "leaky gut" may allow the passage of bacteria, toxins such as

LPS and metabolites that activate the immune response and induce an inflammatory state into the bloodstream.

3. **Nutritional factors in ASD[8]:**

Gastrointestinal problems like constipation, diarrhoea as well as food allergies, eating disorders can make it hard for children with ASD to get the nutrients they need. Diets may also have deleterious effects on the brain development and cognitive function processing. Diet that are high in saturated fat have been associated with impairment of cognitive processing and an increased risk of neurological deficits. The synthesis of neurotransmitters like serotonin and dopamine are regulated by dietary fluctuations in the availability of their nutrient precursors. In ASD, there is a linking alterations in brain levels of dopamine, serotonin, acetylcholine and gamma amino butyric acid with derangements of vitamins, minerals and trace elements. Antioxidants, vitamins, minerals, and trace elements are needed for the normal metabolism of neurotrophic factors and neurotransmitters in the brain.

NUTRITION AND MICROBIOTA[9]:

Diets can have considerable beneficial or negative influences on the composition and functionality of the gut microbiome. A diet rich in diverse plant-based foods particularly dietary fibers promotes the growth of beneficial microbes such as *Bifidobacteria* and *Lactobacilli*. These microbes ferment fibre into short chain fatty acids (SCFAs) which support gut health and reduce inflammation. Certain gut microbes synthesize essential vitamins such as vitamin K and B that are crucial for metabolic processes. Gut bacteria also aids in breaking down proteins and fats influencing energy balance and lipid profiles. The gut-brain axis highlights how gut microbes influence brain health with diet playing a role in modulating microbial signals affecting mood and cognition.

***AYURVEDIC* PERSPECTIVE ON GUT HEALTH AND AUTISM:**

1. ***Agni* and *Ama*[10]:**

Agni, according to *Ayurveda*, refers to digestive fire or metabolic energy responsible for transforming food into nutrients that the body can assimilate and use for various physiological functions. It is considered most important as it governs not only digestion but also metabolism, absorption and assimilation of nutrients. Gut is considered to be the centre of *Agni* and is the initial site of digestion. The *Ayurvedic* notion of *Agni* and the idea of gut microbiome appear to be closely related and can be applied to enhance gut health. In addition to supporting metabolic functions and intestinal health, *Agni* can also have an impact on psychological well-being. *Ayurveda* also explains that most of the diseases are caused by an accumulation of *Ama* which can be formed as a result of reduced *Agni*. *Ama* is initially formed in the digestive tract but at a later stage of disease it can leak into the bodily tissues and turn into *Ama Visha* that leads to tissue disruption and chronic inflammation. The production of *Ama* is due to *Apakva Dhatu Parinama* or *Dhatvagni Mandhya Janya Ama*. *Ama* will further causes *Srota Avarodha* which results in malfunctioning of various *Dhatus* and as a result it will lead to *Oja Kshaya* which further leads to poor immunity, recurrent infections and uncommon behavioural symptoms which is the result of *Manovaha Srotas Dushti*.

2. **Relation between *Agni* and *Manas*[11]:**

Agni is responsible for metabolizing food and maintaining physiological functions. The state of *Agni* is believed to influence not only physical health but also mental well-being. When *Agni* is balanced, it supports the proper digestion and absorption of nutrients. However, imbalances in *Agni* can lead to various health issues, including mental disturbances. *Manas Vikara* can also affect *Agni*. Therefore, there is bidirectional relationship between *Agni* and *Mana*. Maintaining balanced *Agni* through proper diet, lifestyle and stress management techniques can support both physical and mental well-being. It is said that wholesome food taken even in proper quantity do not get properly digested when the individual is afflicted with grief, fear, anger, sorrow, excessive sleep and excessive vigil.

3. ***Tridosha* and *Manas*[12]:**

Functions of balanced and imbalanced *Tridoshas* and their effect on *Manas* has been explained in *Charaka Samhita, Sutrasthana Vatakalakaliya Adhyaya*. It is as follows:

- ✓ Balanced or *Prakruta Vata* initiates all the actions and speech.
- ✓ *Niyanta Praneta Cha Manasaha Vata* controls and directs the mind.
- ✓ *Sarva Indriyanam Udyojakahait* coordinates, stimulates all the sense organs.
- ✓ *Sarva Indriya Arthanam Abhivodait* controls all the objects of sense faculties.
- ✓ Imbalanced *Vata* perturbs the mind, affects all the sense organs and sense faculties.

DIETARY APPROACHES IN AUTISM:

1. **Probiotics[13]:**

Probiotics contain living microorganisms and are administered to promote health by stimulating immunity, strengthening the intestinal barrier, increasing the expression of mucine, reducing the overgrowth of pathogens and producing vitamins and antioxidants. The most commonly used probiotics are *Bifidobacterium* spp and *Lactobacillus* spp.

2. **Prebiotics[14]:**

Dietary prebiotics were defined as a selectively fermented ingredient that results in specific changes in the composition and or activity of the gastrointestinal microbiota, thus conferring benefits upon host health.

3. **Gluten free and Casein free (GFCF) diet[15]:**

Allergens such as gluten disrupt the intestinal epithelial barrier function and thus result in an abnormally increased intestinal permeability. In an intestine with abnormal intestinal permeability, opioid peptide products formed as a result of gluten-casein metabolism pass into the bloodstream, where they bind to the opioid receptors. From there they are passed into the central nervous system and the neurotransmitters therein are affected. By restricting gluten and casein in GFCFD, the production of opioid peptides that will provide this transition is prevented.

4. **Low oxalate diet[16]:**

In individuals with ASD, some substances such as oxalate can disrupt neurological development and cause abnormalities in the nervous system. Some metabolic disorders, including high levels of oxalate in blood serum, cause more intense clinical symptoms in these individuals.

5. **Polyunsaturated fatty acids (PUFAs) [17]:**

PUFAs have been identified as a key factor in normal brain growth and development and have been implicated in such areas as synapse and memory formation and cognitive function development.

6. **Antioxidants[18]:**

Impairments in antioxidant defence systems may lead to alterations in neuronal structure and brain function, inflammation and disruption of immune function. Dietary antioxidants include vitamin E, vitamin C, carotenoids, selenium, manganese, copper and zinc. Supplementing diets with vitamin C, vitamin B6 and flavonoids or administering foods with potential therapeutic properties were reported to ameliorate symptoms of ASD.

7. **Ketogenic diet[19]:**

Ketone bodies have neuroprotective effects in the brain. They normalize mitochondrial function by stimulating mitochondrial biogenesis, reducing oxidative stress, which reduces neuronal death, regulate neurotransmitters and increase γ-aminobutyric acid (GABA) levels. Ketone bodies also inhibit the activation of the mammalian target of rapamycin (mTOR) signaling pathway and decrease seizures.

8. **Vitamins and minerals[20]:**

ASD children may have dysregulations in vitamin and micronutrient availability due to the many reasons associated with dietary behaviours and metabolic imbalance. Oral vitamin supplementation is effective in ameliorating the metabolic and nutritional status of ASD children such as alleviation of glutathione, methylation, sulfation, oxidative stress, NADH, ATP and NADPH.

9. **Special carbohydrate diets[21]:**

In the special carbohydrate diet (SCD), complex carbohydrates and processed foods are restricted. SCD is aimed to prevent malabsorption of foods that are more difficult to digest, prevent the formation of undigested residual nutrients and as a result, prevent the growth of pathogenic bacteria in the intestine.

***AYURVEDIC* INTERVENTIONS:**

1. ***AHARA*:**

Acharya Kashyapa has considered *Ahara* as *Mahabhaisajya*. He has explained *Chaturvimshati Vikalpa Ahara* which are essential for good health, strength, proper growth and development[22].

Acharya Charaka has described the importance of *Ahara* and he has explained the relationship between food and mind for proper nutrition. If properly taken they produce energy in mind otherwise they become harmful[23].

2. ***PATHYA-APATHYA*[24]:**

The foods indicated for Autism are Cow's milk, *Go Ghrita*, *Purana Shali*, *Shashtika*, *Draksha*, *Yava*, *Lajasaktu*, etc. The foods that are contraindicated for autism are alcohol, pungent, spicy food, penetrative, irritant food, incompatible and polluted food.

3. ***DEEPANA –PACHANA*[25]:**

Acharya Charaka has described *Deepaniya Mahakashaya* which can be used for *Agni Deepanam*. *Deepaniya Dravyas* play the vital role in stimulating *Jatharagni* in case of *Mandagni* and *Mandagni* induced *Rasa*

Pradoshaja diseases. *Guna* and *Karma* of *Deepaniya Mahakashaya* well explains its importance in treating disorders of Gastro-intestinal tract and its complications if prescribed correctly.

4. *MEDHYA RASAYANA*[26]:

Acharya Charaka has described four *Medhya Rasayanas* such as *Mandukaparni, Yashtimadhu, Guduchi*, and *Shankhapushpi* for improving the intelligence. *Medhya* drugs activate brain function by improving the function of *Agni* and get better circulation of *Rasa* by opening and cleaning the micro channel for improve mental performance. Main function of *Medhya Rasayanas* is to improve power of grasping, power of retention and memory. The pharmacodynamic action of *Medhya Rasayana* having *Shita Virya* and *Madhura Vipaka* promotes *Kapha* and enhances "*Dharana Karma*". *Medhya Rasayana* having *Ushna Virya* and *Tikta Rasa* promotes *Pitta* and enhances "*Grahana Karma*". Thus, the administration of *Medhya* drugs in autistic children helps to maintain and restores the body's harmony, improving balance between the brain and nervous system.

5. *TAKRA*[27]:

Takra has been proved to be very beneficial in *Grahani Dosha* and not limited just to *Udara* and *Arsha* but also *Grahani Dosha* associated with *Agni Vikriti*. *Takra* plays the role of *Deepana, Grahi* and *Laghuvatva* property and thereby improves the *Grahani*. By its *Tridoshghna Guna, Takra* is useful in *Pitta Dosha* with its *Madhura Vipaka*. It is useful in *Kapha Dosha* by its *Kashaya Rasa, Ushna Virya, Vikasitva* and *Ruksha Guna*. It is useful in *Vata Dosha* by its *Snigdha Guna, Madhura* and *Amla Rasa*.

6. *GHRITA*[28]:

Ghrita preparations can absorbs and readily enters the brain through the blood-brain barrier. Some of the *Ghrita* preparations which are beneficial in ASD are *Kalyanaka Ghrita, Mahakalyanaka Ghrita, Brahmi Ghrita, Mahapaischika Ghrita*.

7. *PANCHAKARMA*[29]:

Shodhana therapy aims at removal of the vitiated *Doshas* and correction of *Agni* which are the prime causative factors of all diseases. It also facilitates the link between sense organs and brain efficiently. In autism, *Nasya, Shiro Dhara* and *Basti* are important procedures.

DISCUSSION:

Autism Spectrum Disorder (ASD) presents with a constellation of neurodevelopmental symptoms that are increasingly being understood through the lens of gut-brain axis dysfunction. The *Ayurvedic* perspective offers a holistic and time-tested framework to address this complex interplay, primarily through the regulation of digestion (Agni), restoration of gut integrity and nourishment of the mind and intellect. *Ayurvedic* concepts of *Ahara, Pathya-Apathya, Medhya Rasayana, Deepana Pachana*, and *Panchakarma* therapies align remarkably with contemporary understandings of gut health in autism. Each of these approaches targets not only the physical body but also the mind, thus addressing the core features of autism such as speech delay, poor eye contact, irritability and hyperactivity. The emphasis on *Ahara* as the first and most important pillar of health underscores its therapeutic value in ASD. Furthermore, the use of *Pathya* practices to individualize dietary regimens based on *Prakriti* and *Vikriti* can be a vital step in improving gut function and behavioural symptoms. *Deepana* and *Pachana* play a central role in managing *Mandagni*, which

is considered the root of *Ama* production and systemic imbalance. The *Deepana Mahakashaya* group of herbs are particularly relevant for children showing signs of poor digestion, bloating, or constipation symptoms frequently observed in ASD. Another crucial intervention lies in the administration of *Medhya Rasayanas* like *Mandukaparni, Yashtimadhu, Guduchi* and *Shankhapushpi* which not only nourish the *Majja Dhatu* and enhance cognitive function but also exert adaptogenic and neuroprotective effects. These herbs align with modern phyto pharmacological findings that support their potential benefits in neurodevelopmental disorders. Finally, *Panchakarma* therapies especially *Basti* offer unique detoxification and rejuvenation strategies, particularly suited to balancing *Vata Dosha*, which is often implicated in the erratic and fluctuating symptoms of autism. Overall, the *Ayurvedic* approach to nutrition and gut health in ASD not only addresses symptomatic relief but also fosters systemic balance and mental well-being. Future interdisciplinary research integrating *Ayurvedic* principles with modern biomedical insights could further validate these approaches and enhance the quality of life in children with autism and their families.

CONCLUSION:

Nutrition and gut health play a vital role in the management and treatment of Autism Spectrum Disorder (ASD). Improving the nutritional status of individuals with autism not only enhances their overall well-being but also supports better medical outcomes. Healthy eating habits can help reduce core symptoms, improve behaviour, manage associated health issues, and significantly enhance the quality of life. A comprehensive approach that addresses digestive imbalances, gut microbiome dysbiosis and nutritional deficiencies can lead to noticeable improvements in symptoms and behaviour. By integrating these *Ayurvedic* principles with dietary and therapeutic interventions, we can promote the holistic development and well-being of children with ASD.

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