



## AN AYURVEDIC OUTLOOK ON INFANT FOOD HABITS WITH REGARD TO GUT MICROBIOME EVOLVEMENT

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### ABSTRACT

Being very delicate by nature, *Bala* is always dependent on care takers for their basic requirements which include food. Interestingly, parents too are worried regarding their baby's growth, development, food habits, and weight gain pattern and rush to hospitals when they go wrong. That would be the reason why age classification in *Ayurveda*, was completely done with respect to infant food habits. Peeping into the development of the digestive system, it is from week three to week thirty-two that the baby develops his own gut, being divided into the foregut, midgut, and hindgut. Nutrition is an inevitable criterion in developing the gut microbiome and thus improving gut immunity which serves to be an essential factor in infant development to adulthood. Concurrently, each one of us must be aware of what our children eat and conscious of its sequel. AIM: Providing an insight to Ayurvedic scholars and infant care takers on infant food habits and their influences on gut microbiota development having impacts till adulthood. MATERIALS AND METHODS: Acknowledging the lack of sufficient information on parents and caretakers of children, raised the need of compiling the data required for analysis of the gut microbiome and the food they provide to their kids. That would illuminate the necessity of properly following breastfeeding exclusively until six months and weaning with a balanced diet to come up with a healthy gut. The approach consisted of thorough searching of several resources which includes *Ayurvedic* treatises, books, dissertations, conference proceedings, and web-based scientific databases. The key words that were used for the search consist of

the gut microbiome in babies, foetal embryology of gut development, food, and gut microbiome, weaning food in babies, and food and gut development in children. Doing a proper literary review revealed that there are sparse tries to enfold the same and the need to compile it came up. This would help in understanding the concept of the gut microbiome and how the food of children can influence it. **CONCLUSION:** First six months of life where breastmilk is the only exclusive food, marks the shaping of the gut microbiome followed by the impacts of weaning food recipes. This shapes the gut microbiota development by providing different healthy microbes for the gut which has its definitive influences on disease prevention strategy. The role of infant dietary habits in the evolution of gut microbiota is less understood by Ayurvedic scholars and paediatric caretakers, which is emphasised here in.

**Keywords:** Infant food habits, gut microbiome, weaning recipes, gut development, Ayurveda food for weaning, gut development

## INTRODUCTION

May it be any concepts in Ayurveda, if that relates to *Bala* (child), the importance of age and its influences play a vital role. Even though a vast dimension is given to understand the scope of *Bala*, we would be very confined to only with infantile age group and their food habits. Babies are immature by organ & system development, secondary sexual characters which are not yet completely manifested, and are unable to tolerate the heaviness of troubles which makes them fragile from a health perspective<sup>1</sup>. Being very delicate by nature, *Bala* is always dependent on care takers for their basic requirements which include food. Interestingly, parents too are worried regarding their baby's growth, development, food habits, and weight gain pattern and rush to hospitals when they go wrong. That would be the reason why which age classification in *Ayurveda*, was completely done with respect to infant food habits – *Ksheerada* (babies who are fed with only breastmilk and under the age of 1 year), *Ksheerannada* (babies who started with weaning but consumes both breastmilk and other smashed foods and remain in-between 1 – 2 years), *Annada* (children above 2 years where solid foods include their major diet)<sup>2</sup>. *Ahara*, considered as *Mahabhaishajya*<sup>3</sup>, is given prime importance as it provides nourishment, aids development, sustains life, and if improperly fed may result in disease that can put your baby's life in danger. Peeping into the development of the digestive system, it is from week three to week thirty-two that the baby develops

his own gut, being divided into the foregut, midgut, and hindgut<sup>4</sup>. But during fetal life, his digestive tract has a very minimal role in breaking down the food as baby do not eat food directly but is supplied with necessary nourishment via the placenta and umbilical cord. Baby's gut, being near to sterile at birth is filled to overflow with varieties of microbiomes which gradually support them to reach the adult gut standards. Concurrently, it is important that each one of us should be aware of what our children eat and conscious of its sequel. Nutrition is an inevitable criterion in developing the gut microbiome and thus improving gut immunity which serves to be an essential factor in infant development to adulthood<sup>5</sup>.

## MATERIALS AND METHODS

Acknowledging the lack of sufficient information for parents and caretakers of children, raised the need of compiling the data required for analysis of the gut microbiome and the food they provide to their kids. That would illuminate the necessity of properly following breastfeeding exclusively until six months and weaning with a balanced diet to come up with a healthy gut. The approach consisted of thorough searching of several resources which includes *Ayurvedic* treatises, books, dissertations, conference proceedings, and web-based scientific databases. The key words that were used for the search consist of the gut microbiome in babies, foetal embryology of gut development, food, and gut microbiome, weaning food in babies, and food and

gut development in children. Doing a proper literary review revealed that there are sparse tries to enfold the same and the need to compile it came up. This would help in understanding the concept of the gut microbiome and how the food of children can influence it.

### GUT MICROBIOME

There are millions and millions of microbes that survive in the human intestines which are nearly sterile at the time of birth and grow up gradually influenced by the food habits of children till adulthood<sup>6</sup>. This slow development of the gut microbes starts from birth and reaches adult gut standards by three years of age and is determined by various factors like mode of delivery, food that baby consumes starting from birth to later life, geographical factors, and even the environment in which he grows<sup>7</sup>. Since we have been confined to infancy-related food habits, the period of weaning, where a shift from exclusive breast feeding to semi-solid and thereafter to solid food introduction ensue, plays a prime role in the evolution of the gut flora. This serves as seeding to pave a healthy core gut microbial profile in adulthood<sup>8</sup>.

### AYURVEDIC OUTLOOK ON INFANT FOOD HABITS

*Ksheerada*, the duration from birth to one year, where the baby is relied on exclusive breastmilk feeding, as it supplies the nutritional demands during that age, emphasizes the necessity of safe and pure breastmilk supply. Whatsoever food that the pregnant lady consumes is split up to nourish the lady herself, to nourish the growing foetus, and to provide nourishment to breasts to bestow healthy breastmilk in the post-natal time<sup>9</sup>. The nutrient-rich portion of that food circulates all around the body of the mother and reaches the breasts ensuring that her milk is rich in nutrients, oxygen, antibodies, and helpful microbes of more than 200 strains, which when received by the baby ensures the establishment of healthy gut microbes providing lifelong outcomes on health and immunity<sup>10</sup>. In *Ksheerannada*, from one year to two years, the baby

along with the breastmilk consumes semi-solid and later solid food recipes, which marks a major milestone in infancy. This dietary shift practically happens during weaning time, after completion of the exclusive breast feeding period. The introduction of different foods during weaning brings in diverse microbial growth in the infant's gut, which helps them grow to adult standards. Hence, it is important for parents and care takers to understand this unavoidable yet prime step in the infant feeding series. For this reason is why *Balabilwa modaka*, *Shashatika shalyadi modaka*, *Priyala majjadi modaka*, *Dhataki pushpyadi modaka*, etc. recipes are mentioned in classics<sup>11</sup>. During *Ksheerannada kala*, children of more than two years, stop breastmilk feeding and proceed with solid food preparations and there after following adult-like food habits which again strengthen the gut microbial diversity and there by improving immunity.

### PHALA PRASHANA & ANNA PRASHANA

Concentrating on the weaning period of an infant, *Phala prashana* and *Anna prashana* are the two inevitable yet important rituals to be performed giving utmost care to the baby's needs. *Phala prashana*<sup>12</sup>, to be done at the sixth month of life, which marks the beginning of the introduction of fresh fruit juices and smashed fruits and vegetables, initiation of cereals and pulses-based purees is followed by *Annaprashana*, which guides the introduction of soft and solid food at 10<sup>th</sup> month<sup>13</sup>. Considering this, liquid & semi-solid food preparations and later solid ones are introduced in a child after completion of six months until two years which is a juncture where if the baby is fed with improper feeding practices, mislead hygienic implementations, inadequate quantity and quality of the recipes selected, insufficient calculations of calorie intakes, etc. results in various health impacts. An estimated six hundred thousand under-five deaths are prevented by implementing hygienic and safe, schemed, and systematic food introduction<sup>14</sup>. In a similar manner, too early or very late weaning food introduction may result in the varied health status of the infant. The role of prioritiz-

ing *Phala prashana* and *Anna prashana* can thus be appreciated.

## DISCUSSION

Each child gets their gut microbiota evolved in a vertical (acquired from mother to child) and a horizontal (from the environment, food, etc.) fashion<sup>15</sup>. **The phases of growth of the microbiota in the gastrointestinal tract can be explicit with the developmental phase (3–14 months of age), transitional phase (15–30 months), and stable phase (31–46 months)**<sup>16</sup>. This makes the scenario crystal clear that the microbiota development of the gut during infancy and childhood can influence disease prevention in adulthood. Divergent microbes being present in the infant's gut can help in the production of vitamins, increases digestion of nutrients and supports intestinal motility influencing and stimulating the immune functions of the child, which is in the developmental phase<sup>17</sup>. This marks the importance of gut microbes in the sustenance of human life. Many sequels from allergic manifestations, asthma, etc. to chronic inflammatory diseases can arise due to imbalances in the gut microbiome specially during the early developmental stage of an infant's gut and the same can end in life long health implications, even in adulthood<sup>18</sup>. Oligosaccharides, that are present in human milk help in promoting the composition of gut microbes and hence improve metabolism catalysing the overall gut development<sup>19</sup>. *Staphylococcus*, lactic acid bacteria, and *Streptococcus* are plentiful in colostrum whereas there occurs a dramatic reduction of *Staphylococcus* after a month of life<sup>20</sup>. During the period of exclusive breastmilk feeding, the high relative abundance of *Bifidobacterium* was noticed and lower flourishing of *Veillonellaceae*, *Enterococaceae*, *Lactobacillaceae*, *Enterobacteriaceae*, *Streptococcaceae*, which are other breastmilk associated bacteria were found out<sup>21</sup>. Even so, once the weaning food introduction with complimentary feeds starts, there was an increase in diverse groups of *Lachnospiraceae* and *Ruminococcaceae* species along with a decrease of *Bifidobacterium*, *Enterobacteriaceae*, *Enterococca*

*ceae*, *Lactobacillaceae*, *Veillonellaceae*, *Clostridiaceae*<sup>22</sup>. There was an overall increase in total diversity which was probably seen because of the high fibre and protein content of the infant diet<sup>23</sup>. Childhood obesity, different immune system-related diseases, and oxidative stress are related to the early introduction of weaning foods and thus have a vital role in not encouraging the same<sup>24</sup>. Thereafter, once breastmilk feeding is stopped and the infant being continued with the family pot feeding, an increased abundance of *Bacteroidaceae*, *Lachnospiraceae*, and *Ruminococcaceae* and a further reduction in *Bifidobacterium* along with increased alpha diversity was observed<sup>25</sup>. This emphasises the role of dietary habits in gut microbiome development and its effects in adulthood.

Considering the core aspects of *Bala ahara vyavastha*, *navajatha peya*, a preparation with *guda*, *ajamoda*, and the prescribed quantity of water is soaked in a clean cotton wick and given for the baby to lick as it can nourish the baby in the initial two-three days where breastmilk secretion is not yet completely established<sup>26</sup>. The initiation of *Sthanya* (mother's breastmilk) provides all the necessary requirements of the baby, as it is species-specific and baby specific. Being baby specific indicates that each mother produces breast milk in the manner that her baby needs nourishment. The needs of a preterm baby will be fulfilled only by the baby's own mother as her milk contains the growth factors necessary for that preterm baby and cannot nourish enough a baby who is not hers. This establishes the need for breastmilk in a baby's diet, which is the first safe and healthy food that the baby receives. It is through breast milk that the neonate gets the initial shaping of his gut microbiome, as it serves as the pathway of transmission of oligosaccharides, secretory IgA, and anti-microbial factors. At the completion of six months, when the baby is fed with breastmilk along with fruit juices and smashed foods (*Phala prashana*), ensures that nourishment is provided as per the baby's demands. This establishes gut development by the provision of diversified microbe introduction through newer food initiation which is a major mile-

stone in infant growth and development. Cereals, which are the major ingredient in many of the weaning preparations, have microbiota-accessible substrates that fuel the microbiome<sup>27</sup> survival in the infant's gut. Even oats formulations, containing high  $\beta$ -glucan, lipid content, or a unique antioxidant profile, has a distinct role to play in the development of healthy gut microbes<sup>28</sup>. Pulses have the potential capability to modulate gut health and vanish the risk of different metabolic disorders by varying the microbes in the gut positively and strengthening the mucous environment in the colon<sup>29</sup>. Healthy eating habits of required amounts of fruits and vegetables not only improve physical fitness and physiologic bodily functions but has a significant role in modifying gut microbiota<sup>30</sup>. *Balabilwa modaka* containing *bala bilwa*, *ela*, *sharkara*, and *laja sakthu* acts as a *deepaka sthanyapanayana dravya* (weaning food), *Shashtika shalyadi modaka* having *shashtika shali* rice in it, *Priyala majjadi modaka* having ingredients like *priyala majja*, *madhuka*, *laja*, *sithopala* along with honey acts as *brihmana* weaning recipes whereas *Dhataki pushpyadi modaka* containing *dhataki pushpa*, *sharkara*, and *laja tarpana* is *sangrahi* in nature<sup>31</sup>. That which kindles the digestive fire is *deepana* in nature<sup>32</sup>, that which digests the undigested is *pachana*<sup>33</sup>, preparations having the ability to nourish are *brihmana* in quality<sup>34</sup>, and those having ability to dry up the water content is known for its *sangrahi* property<sup>35</sup>. Analysing these properties, it is evident that these formulations along with the *sthanya*, not only nourish the baby's gut but prepare his gastrointestinal tract to digest the food completely and evolve the gut as per the adult calibre. The influence of recipes of ragi in providing calcium supplementation indirectly may influence the teeth eruption during the seventh month onwards and may assist the closure of anterior and posterior fontanelle, bone ossifications, etc. marking the infant's growth. All the aforesaid formulations serve as a major diet during the weaning time in infancy.

## CONCLUSION

Immature by growth and development, children need support from an efficient caretaker to provide their basic requirements including food supplementation. The first six months of life where breastmilk is the only exclusive food marks the shaping of the gut microbiome followed by the impacts of weaning food recipes. That shapes the gut microbiota development by providing different healthy microbes for the gut which has its definitive influences on disease prevention strategy. The role of infant dietary habits in the evolution of gut microbiota is less understood by Ayurvedic scholars and paediatric caretakers, which is emphasised above said. For this reason, Ayurveda has given the classification of age with the major criterion being the food that the infant consumes. Shaping the gut microbiome in a healthy manner has its essential role in disease prevention and health promotion, influencing them until adulthood.

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