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ROLE OF AYURVEDA INTERVENTION (CHATURJATADI SAMBHARAK AVALEHA) IN THE MANAGEMENT OF MALNUTRITION IN CHILDREN

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Keywords:

Malnutrition, Balshosha, Deepana, Pachana, Brumhaniya, Rasayana, Chaturjatadi Sambharak.

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ABSTRACT: Balashosha is a disease caused by nutritional deficiencies in which the body gets slowly emaciated. This condition is very much similar to malnutrition. It reduces the baby's growth and increases the chances of having a low birth weight and later suffering from childhood infections and mortality. In Ayurveda, Balashosha is described as Apatarpana janya vyadhi and due to Rasavaha Shrotodusti, where Kaphadosha plays an important role in the pathogenesis. **Aim:** Aim of this article is to evaluate the efficacy of Chaturjatadi Sambharak in the management of Malnutrition (Balashosha). **Materials and Methods:** A literature review was conducted with the help of many important Ayurvedic and Modern textbooks, Research papers, Journals to collect information on the content of Chaturjatadi Sambharak, an Ayurveda drug indicated for Ajeerna(indigestion), Shvasa (dyspnoea), Kasa (cough), Sarvarognashaka (cures every disease), Balya (Strength promoting), Angavardhaka (Anabolic/growth-promoting) and Pushtikaraka (promoting nutrition) in children. **Conclusion:** This literary review article provides evidence regarding the immunomodulatory, antimicrobial, Antioxidant activity along with Deepana (appetizer), Pachana (digestive), Krimihara (antihelminthic), Brimhana (anabolic/ growth-promoting), and Rasayana (rejuvenating) properties of the drug. These are responsible for increasing in body mass and managing morbidities associated with malnutrition. Therefore, it can be considered as an effective remedy for the management of malnutrition.

INTRODUCTION: Malnutrition in children is a major health burden in developing countries utilizing major resources. The prevalence of stunting, wasting, and underweight under five years of children are 48%, 20% and 43% are respectively¹. The prevalence of Severe Acute Malnutrition

(SAM) in India is 7.5%². Malnourished children are more prone to systemic infection because infections aggravate malnutrition by decreasing appetite, inducing catabolism, and increasing demand for nutrients³.

It is experienced during early life, which inhibits growth and development, causes mental retardation, reduces motivation and energy level. Every year, approximately 2.3 million deaths among 6 months-5 years aged children in developing countries are associated with malnutrition, about 41 % of the total deaths in this age group⁴.

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Malnutrition is caused by several factors such as poverty, including lack of access to food, educational status, health care, child abuse, sanitation services, appropriate child feeding, and caring practices. This problem is mainly related to improper uptake, digestion, and absorption of various vitamins, minerals, and trace elements in growing children. The government of India has initiated and implemented many programs to combat malnutrition among school children by providing them one nutritious meal 'mid-day meal at school and some other programs also running e.g.- National Health Mission (NHM), RBSK, Poshana Abhiyana, Mission Indra dhanush etc but still the graph is same despite of initiation, there is no satisfactory solution and management for malnutrition.

Several factors may be associated with this poor outcome, like non-compliance of the schemes, non-absorption of the diet due to reduced agni (digestion, absorption, and assimilation of the diet taken by the child due to chronic malnutrition), poor bio availability of the diet. Malnutrition affects the growth and development of a child in terms of decrease in weight and height. There is also loss of appetite as in kwashiorkor, infections, anorexia, etc., worm infestation is also a contributing factor along with poor food. Although nutritional rehabilitation is SA the mainstay of management but digestion, absorption, and assimilation of the diet are important at the same time.

Therefore along with nutrients, all these factors should also be addressed and managed. Ayurveda focuses on both the nutrition as well as its proper digestion, absorption and assimilation. Any nutritious food is useless unless it is properly digested, absorbed and assimilated.

Further, malnutrition leads to immune deficiency in children which provides favorable chances for various infections which again lead to further deterioration of the health of children. In Ayurveda, malnutrition is similar to nutritional disorders like-Balashosha, Karshya, Balkshaya, Ksheeraj Phakka, Parigarbhika and Shushka Revti. Balashosha and Ksheeraj Phakka are caused due to Rasavahasrota savarodh due to Kaphavardhakaahara-vihara - which leads to vitiation of Kapha which further leads to Agnidushti and production of Aama Rasa and Mandagni leading to inadequate Rasa dhatu and improper absorption which finally fail to nourish tissue due to insufficiency. All dhatu or tissue do not get nourishment due to alparasadhatu leading to deficiency of nutrition causing Balashosha / Nutritional Deficiency Disorders. Ayurveda provides mounting references of drugs which are indicated to manage malnutrition. The virtue of Deepana-Pachana, Vrimsaniya and Rasayana properties of drugs can be useful to reduce the severity of malnutrition. Also at the same time the immunity of the children should also be enhanced to prevent infections. Chaturjatadi Sambharak Avleha is one of such drugs indicated for Arochaka, Pratishtaya, Jwara, Kasa, Mukha Snigdghata and Mukha Shwetata which are the features of malnutrition in Ayurveda. With this aim, the present review is an attempt to provide evidences regarding the efficacy of Chaturjadi Sambharakavlehain the management of malnutrition in children.

MATERIAL AND METHODS: Information regarding the conditions which is similar to malnutrition were referred from the classical Ayurveda texts, various internet sources and research papers were critically analysed along with the clinical experiences in managing malnutrition.

TABLE 1: CHATURJATADI SAMBHARAKA (GADANIGRAHA, BALROGADHIKARA, 11/77-79)

S. no	Name of drug	Latin name	Part used	Proportion
01	<i>Dalchini</i>	<i>Cinnamomum zeylanicum</i>	Twak, Taila, Leaves	01 Part
02	<i>Ela</i>	<i>Elettaria cardamomum</i>	Seeds	01 Part
03	<i>Tejpatra</i>	<i>Cinnamomum tamal</i>	Leaves	01 Part
04	<i>Nagkeshar</i>	<i>Mesua ferrea</i>	Punkeshar	01 Part
05	<i>Talishpatra</i>	<i>Abbiswebbiana</i>	Leaves	01 Part
06	<i>Kushtha</i>	<i>Saussurealappa</i>	Root	01 Part
07	<i>Shunthi</i>	<i>Zingiber officinalis</i>	Rhizome	01 Part
08	<i>Marich</i>	<i>Piper nigrum</i>	Fruit	01 Part
09	<i>Pippali</i>	<i>Piper longum</i>	Fruit, Root	01 Part
10	<i>Chavya</i>	<i>Piper retrofractum</i>	Root, Fruit	01 Part

11	<i>Pippalimula</i>	<i>Piper longum</i>	Root	01 Part
12	<i>Tavaksheera</i>	<i>Bambusaarundinacea</i>	Root, Leaves, Fruit	01 Part
13	<i>Sveta Jeera</i>	<i>Cuminum cyminum</i>	Seeds	01 Part
14	<i>Ashwagandha</i>	<i>Withaniasomniferum</i>	Root	01 Part
15	<i>Khand(Sharkara)</i>	<i>Saccharum officinarum</i>	-	28 Part
16	<i>Ghrita</i>	<i>Butyrumdepartum</i>	-	28 Part

Dalchini:

Botanical name – *Cinnamomum zeylanicum*,
English name - Cinnamon bark

Chemical Compositions⁵: Cinnamaldehyde, eugenol, benzaldehyde, methyl amylketon, phellandrene, pinene, cymene, linalool, cumic aldehyde, caryophyllene, safrole, methyl evgenol, cinnzeylanin, borneol, cinnamyl alcohol, cinnzeylanol and epicatechin.

Therapeutic Properties and Uses: Deepana (appetizer), Pachana (digestive), Vatanulomana (carminative), Krimighana (antihelminthic)⁶ Aruchi (anorexia), Kandu (urticaria) and Aamdoshanashaka (digestion of ama dosha)⁷.

Pharmacological Actions:

Antimicrobial Activity: Studies report that *Cinnamomumzeylanicum* demonstrated potential anti-microbial activity against a wide range of bacteria (*Klebsiella pneumonia Streptococcus pneumoniae Streptococcus pyogenes Escherichia coli, Haemophilus Influenza, Helicobacter pylori, etc.*). Further, it has shown activity against various fungi (*Aspergillus flavus, Aspergillus fumigatus. Aspergillu snididans, Aspergillus niger, Aspergillus ochraceus, Aspergillus parasiticus, Aspergillus terreus, Candida albicans, Candida glabrata, Candida krusei, etc.*). *C. Zeylanicum* has also exhibited activity against human rota-virus⁸.

Gastro Protective Effect: Treatment with *C. zeylanicum* replenished the ethanol-induced reduced levels of gastric wall mucus⁹. *C. zeylanicum* extracts reduced the extent of the diarrhoea significantly at 100 and 200 mg/kg doses in test animals¹⁰.

ELA: Botanical Name- Elettariacardamomum, English Name - Cardamom.

Chemical Composition: Borneol, camphene, P-cymene, geraniol, heptane, D-limonene, linalool, menthone, methylheptenone, nerylacetate, nerol, myrcene, α -& β -pinenes, camphor, citral,

citronellal, farnesol, saibenene, α -& β -terpeneols, n-alkanes, ascaridole, sitosterol, thujene.

Therapeutic Properties and Uses¹¹: Rochaka (appetizer), Agnideepana (appetizer), Shwas (dyspnea), Kasa (cough), Kshayanashaka (anabolic), Mutrakruchchhara (dysuria).

Pharmacological Action**Transdermal Drug Absorption Enhancing**

Effect: Elettaria cardamom was found to enhance transdermal drug delivery by altering the barrier property of the stratum corneum. The three components in cardamom oil α -pinene, β -pinene, and α -terpineol exhibited a synergistic effect with 1,8-cineole and d-limonene to increase the permeation of the drug indomethacin¹².

Effect on Nausea and Vomiting: Aromatherapy with inhalation of cardamom oils is effective in relieving nausea caused due to chemotherapy in cancer patients¹³. Oral intake of capsules containing cardamom powder (500 mg) three times a day significantly reduced the severity of nausea and vomiting in pregnancy¹⁴. In Chinese traditional medicine, cardamom was used to treat stomach aches, constipation, bladder infections, and dysentery in children¹⁵. Cardamom capsule powder is used for bronchial asthma patients with excess saliva and mucus in the respiratory tract and as an excellent cough suppressant. Cardamom can be used for controlling cold and related symptoms¹⁶.

Nutritional Effect: The proximate composition of cured cardamom capsules includes carbohydrate 68.2%, protein 10.6%, fat 2.4%, and ash 5.3%.¹⁷ 100 gram of cured capsules contained calcium (93mg), magnesium (182mg), potassium (124mg), phosphorus (183mg), sulphur (100mg) and iron (13mg)¹⁸.

These are essential mineral elements for the normal day-to-day physiological activities of humans. Cardamom capsules and leaves contain significant levels of manganese, zinc, and copper.

Cardamom capsules contain nutritionally important metabolites: flavonoids (catechin, myricetin, quercetin, and kaempferol) and carotenoids (lutein and β -carotene)¹⁹. Cardamom seed oil exerts its antispasmodic action through muscarinic receptor blockage²⁰.

Effect on Digestive Health: In Ayurveda, cardamom is considered an excellent digestive and balancing Kaphadosha, specifically in the stomach and lungs. Also, it pacifies Vatadosha²¹.

Tejpatra: Botanical Name- *Cinnamomum tamala*, English Name - Spice leaf

Chemical Composition²²: *Cinnamomum tamala* chemical constituents eugenol, d- β -phellandrene, cinnamic aldehyde, linalool.

Therapeutic Uses: Aruchi (anorexia), Hallasahara (nausea)²³. Deepana (appetizer), Udarshool (abdominal colic), Atisaarnasaka (antidiarrheal)²⁴.

Pharmacological Action:

Anti-inflammatory Effect: The anti-inflammatory effect of the aqueous extract of *C. tamala* leaves at a dose of 100, 200, and 400 mg/kg showed anti-inflammatory effects by various in vivo and in vitro screening methods. The acute inflammation was evaluated by carrageenan-induced paw edema in rats and acetic acid-induced vascular permeability in mice. *In-vitro* anti-inflammatory activity of extract (concentrations 0.2-1.0 mg/ml) was evaluated by membrane stabilizing activity, i.e., red blood cells (RBC's) exposed to a hypotonic solution in triplicate. The plant extract inhibited significantly, and dose-dependently edema induced by carrageenan in rats also reduced significantly acetic acid-induced vascular permeability in mice. The extract exhibited significant membrane-stabilizing properties in a concentration-dependent manner up to 1 mg/ml in vitro models when compared with Indomethacin²⁵.

Antimicrobial Activity: Several investigations have been performed on the antimicrobial activity of different species of *Cinnamomum* essential oils and crude extracts against several pathogenic microorganisms^{26, 30}. Singh et al., analyzed the antibacterial potential of several essential oils and acetone extract of various spices along with *C. tamala* against *Escherichia coli*, *Salmonella typhi*,

Pseudomonas aeruginosa, *Bacillus cereus*, *Bacillus subtilis* and *Staphylococcus aureus*.

The analysis revealed that the essential oils showed excellent activity against tested organisms as compared to the acetone extract²⁷. In the same way, Kapoor et al., investigated the antimicrobial activity of essential oil and oleoresins of *C. tamala* against bacteria and fungi and reported that both oil and oleoresins revealed effective antimicrobial activity against tested organisms²⁶. Zaidi et al. (2009) examined the bactericidal activity of 50 traditional medicinal plants, including *C. tamala* from Pakistan against seven clinical isolates with special reference to *Helicobacter pylori* responsible for gastrointestinal disorders.

The results revealed significant anti-*Helicobacter pylori* activity of *C. tamala* (>500 μ g/ml)³¹. Another study evaluated the antimicrobial activity of *C. tamala* extracted against four pathogenic organisms and reported that butanol extract showed inhibitory activity against all the tested organisms and remarkable positive results AS compared to another solvent extract³².

A similar study analyzed the crude extract of *C. tamala* for potential antibacterial activity and found that all the extracts (ethanol, methanol and ethyl acetate) showed variable degrees of inhibition zones against different tested bacterial species except hexane extract was found completely inactive³³. The essential oil from *Cinnamomum zeylanicum* bark exhibited in vitro antimicrobial activity against several microorganisms³⁴.

Hepatoprotective Property: The methanolic extract of *C. tamala* leaves demonstrated hepatoprotective activity at two different doses (100 and 200 mg/kg body weight) against paracetamol-induced hepatic damage in Swiss albino mice. The liver marker enzymes (SGOT, SGPT, ALKP, serum bilirubin) and other metabolic parameters (total cholesterol and HDL) were measured in all experimental groups. The changes in liver function parameters were significant compared to the disease control, and the extract's efficacy was comparable to standard drug silymarin and was dose-dependent. The histopathology study of the liver showed improved architecture of liver

cells in the treatment groups showing evidence for hepatoprotective activity of *C. tamala*³⁵.

Antidiarrhoeal Activity: Leaves extract of *C. tamala* (25, 50, and 100 mg/kg, orally) showed a dose-dependent decline in the total amount of faecal matter in diarrhoea induced by castor oil. The extract also showed a significant reduction in the secretion of gastrointestinal fluid accumulation by 32.5-65.0%. Further *C. tamala* significantly reduced the lipid peroxidation and enhanced the catalase activity³⁶.

Nagakeshar: Botanical Name - *Mesua ferrea*, English Name - Cylon Iron -wood, Mesu

Chemical Composition³⁷: Mesuol, Mesuaxanthone A and Mesuaxanthone B and Euxanthone, Mammeisin, Mammegin, Mesuaferone A and B, Mesuein, Mesuaferol, α -amyrin and β -sitosterol, Octadecatrienoic and hexadecenoic acids, Mesuabixanthenes A & B.

Therapeutic Uses: Jwara (fever), Kandu (itching), Chhardi-Hrilashanashana (vomiting-nausea), Vishahar (anti-toxic)³⁸ Deepana (appetizer), Pachana (digestive), Krimighana (anthelmintic), Balya (strength promoting)³⁹.

Pharmacological Action:

Anti Inflammatory Effect: Dried flowers have anti-inflammatory and stomachic properties. A study reported that 80% ethanol extract of stem bark of *M. ferrea* exhibited promising anti-inflammatory activity in a variety of in vitro bioassays⁴⁰. AS compared with standard drug Indomethacin (100 μ g/mL) the 80% ethanol extract showed stronger anti-inflammatory activity at the concentration of 100, 200, and 500 μ g/mL in all the in vitro bioassays⁴¹. The anti-inflammatory activities of xanthenes (mesuaxanthone-A, mesuaxanthone-B, calophyllin-B, euxanthone, dehydro cycloguanandin, jacareubin, and 6-desoxy jacareubin) isolated from *Mesua ferrea* were studied on carrageenan-induced paw oedema, cotton pellet granuloma, and granuloma pouch inflammatory models *in vivo*. All the xanthenes exhibited promising anti-inflammatory activities in all the three models⁴².

Immunomodulatory Effect: Immunomodulatory effect of mesuol isolated from the seed oil of *M.*

ferrea was investigated in both humoral AS well as cellular immune models. In humoral immune response assay, mesuol exhibited a significant rise in the antibody titer values in the previously antibody challenged rats and immunized by the introduction of sheep red blood cells (SRBCs) and immunosuppressed by cyclophosphamide. Further, mesuol also elicited cellular immune responses in cyclophosphamide-treated immunosuppressed rats due to the stimulation of T-cells. When exposed to SRBCs, an increase in the footpad thickness was also found in mesuol treated rats⁴³.

Hepatoprotective Effect: Methanol extract of *M. ferrea* flowers was examined for hepatoprotective effects in *Staphylococcus aureus* inoculated male Wistar rats *in-vivo*. Treatment with methanol extract (50, 100 and 200 mg/Kg) for 1 week exhibited significant improvement in the levels of liver enzymes (CAT, SOD, GPx and GR) along with decrease in AAT and AST enzyme levels. Marked effects were found at the dose of 100 mg/Kg⁴⁴.

Talisapatra: Botanical Name - *Abies webbiana*, English Name - Himalayan Silver fir

Chemical Compositions: Essential Oil & Alkaloid⁴⁵. Abiesin, N-Triacontanol, B-Sitosterol, Betuloside, Abioflavonoid and Abietane⁴⁶.

Therapeutic Uses: Agnimandya (indigestion), Kshaya (emaciation), Chhardi (vomiting), Krimi (worm infestation), Mukhroga (stomatitis), Aruchi (anorexia) Kasa (cough), Swasa (dyspnoea), Deepana (appetizer), Pachana (digestive), Balya (strength promoting)^{47, 49}.

Pharmacological Action:

Anti-Inflammatory Activity: Anti-inflammatory effects were investigated of methanol, chloroform, and petroleum ether extract of *Abieswebbiana* leaves against carrageenan-induced paw edema model in rats and it was found that methanol extract (400 mg/kg p.o.) of leaves exhibited the most significant activity as compared to diclofenac sodium in rat⁵⁰.

Antibacterial Activity: The Antibacterial activity of *Abieswebbiana* leaves were examined for 625 μ g/ml, 1.25 mg/ml, 2.5 mg/ml, 5 mg/ml concentrations by cup plate method against *Staphylococcus aureus*, *Salmonella typhi*, *Escheria*

coli, *Bacillus cereus*, *Bacillus pumilus*, *Bacillus subtilis*, *Bordetella bronchiseptica*, *Micrococcus luteus*, *Staphylococcus epidermidis*, *Candida albicans*, *Aspergillus niger* and *Saccharomyces cerevisiae*. The leaves of *Abeiswebbiana* (625-5000 µg/ml) exhibited significant anti-microbial activity against all tested strains. The leaves exhibited maximum antibacterial activity against *Staphylococcus aureus* and *Salmonella typhi*⁵¹.

Kushtha: Botanical name - *Saussurea lappa*, English name - Costus root

Chemical Composition⁵²: Essential oil, costol, taraxas-terol, costunolide, dehydrocostuhactone, α -cyclostunolide, sitosterol, sesquiterpenes, α -curcumene, isodihydrocostuslactone and costus-lactone.

Therapeutic Uses: Deepana, pachana, up sargnashaka, pratidushaka, rasayana⁵³Kasa, shwas, shulaprashamana, anulomana, agnimandhya, ajirna, daurbalya⁵⁴.

Pharmacological Action:

Antidiarrheal Effect: Methanol extract (MeOH) of *S. lappa* exhibited significant antidiarrheal activity on Wistar rats. The dose of 500 mg/kg body weight exhibited an almost similar effect in reducing diarrheal stool to that of standard drug loperamide⁵⁵.

Effect on Gastric Function: *S. lappa* decoction (SLD) was administered orally as perfusion into the stomach in subjects with chronic superficial gastritis and examined for variation in serum gastrin, plasma somatostatin concentration, and gastric acidity output.

SLD accelerated the gastric emptying time and endogenous motilin release significantly ($P < 0.01$) in five healthy volunteers where AS by perfusion there was no change in plasma somatostatin concentration, serum gastrin levels, and acidity output⁵⁶.

Antiparasitic Effect: The activity of *S. lappa* against nematodal infections was determined. In children with nematodal infections, the efficacy of *S. lappa* was examined based on the percentage reductions in the faecal eggs/gram counts. It

revealed that *S. lappa* extract demonstrated antiparasitic activity^{57, 58}.

Shunthi: Botanical Name - *Zingiber officinale*, English Name - Ginger root, Dry Ginger

Chemical Composition⁵⁹: The ginger plant contains β - curcumene, α - D- curcumene, β -bourbornene, d- borneal, citral, d-camphene, citronellol, geraniol, gingerol, α , and β -Zingiberenes, Zingiberenes, Zingiberol, Zingerone, gingerols, paradol, gingerenone A, ginger glycolipids A,B and C; [6] gingerdiol, gingerone B and C, etc.

Therapeutic Uses: Anulomana, Deepana, Amadosaghna, Hridya, Kaphaghna, Pachana, Ruchya, Vatakaphahara⁶⁰. Used in gastrointestinal disorders and piles⁶¹. In Grahaniroga, improved body weight, appetite, anemia, and diarrhoea⁶². Fresh ginger is used for cold, nausea, asthma, cough, swelling, dyspepsia, and loss of appetite⁶³.

Pharmacological Action:

Bioavailability Enhancing Effect: *Zingiber officinale* acts powerfully on gastrointestinal tract mucous membrane. Ginger regulates intestinal function and facilitates absorption. [6]-gingerol, the major pungent essential oil of *Zingiber officinale* improves the absorption of several drugs by regulating the intestinal function to facilitate absorption of drugs. Gingerol alone exhibited bio enhancing activity in the range of 30-75%, whereas in combination, piperine and gingerol provide the bioavailability of drugs in the range of 10–85%. The bio enhancing dosage of gingerol is 10-30 mg/kg body weight, and piperine is 4-12 mg/kg body weight. Gingerol increases the bioavailability of several antibiotics like Azithromycin, Erythromycin, Cephalexin, Cefadroxil, Cloxacillin, and Amoxicillin^{64, 65}.

Marich: Botanical Name - *Pipernigrum*, English Name - Black pepper, Common pepper, Pepper

Chemical Composition⁶⁶: Piperene, piperethine, piperolein A & B, feruperine, dihydroferuperine, citronellol, cryptone, dihydrocarveol, piperonal, camphene, β -alanine, pipercolic acid, carotene, ascorbic acid and piperide etc.

Therapeutic Uses: Deepana (appetizer), Svasahara (dyspnoea), Sulaprashamana (analgesic), Krimighna (antihelmintic)⁶⁷ Ruchikaraka (appetizer), Krimighna (antihelminthic), Vamananashaka (antiemetic)⁶⁸.

Pharmacological Action:

Bio-availability Enhancing Effect: Piperine, a bitter alkaloid found in *Piper nigrum* Linn augments the bioavailability of several structurally and therapeutically diverse drugs⁶⁹. When co-administered with piperine, several anti-tuberculosis drugs (Isoniazid and Pyrazinamide) had exhibited a greater increase of C_{max} and AUC by 400% and 101%, respectively⁷⁰. The C_{max} and AUC_{0-∞} of propranolol were increased by 100% and 102%, when propranolol was administered along with piperine⁷¹. Also, C_{max} and AUC of resveratrol were increased by 1544% and 229% when piperine was co-administered with resveratrol⁷². When co-administered with beta-carotene, piperine, 60% greater increase of AUC was found compared to β-carotene and placebo⁷³.

A daily supplement is taken with a nutrient or nutrients by an average healthy adult, piperine is effective and safe in a broad dose range. A preferred effective dose range of piperine for oral use to enhance gastrointestinal nutrient absorption is 0.0004-0.15 mg/kg/day. The recommended dose of piperine for a healthy individual for oral use is approximately 5 mg/person/day. Black pepper contains approximately 5-9% piperine, listed by the Food and Drug Administration (FDA) AS an herb that is generally recognized as safe (GRAS) for its intended use as spice, seasoning, or flavoring. The bio-enhancing dose of piperine is approximately 15 mg/person/day and no more than 20 mg/day in divided doses, which corresponds to several thousand to up to 40,000 times less than the LD₅₀ dose of piperine, as established in various experiments on rodents.

The effective bio-enhancing dose of piperine for drug compounds varies, but the prior art studies indicated that a dose of approximately 10% (w/w) of the active drug could be regarded AS an appropriate bio-enhancing dose for most drugs. There are two possible explanations for the role of piperine in drug bioavailability: (a) nonspecific

mechanisms mainly promoting rapid absorption of drugs and nutrients, for example, increased blood supply to the gastrointestinal tract, decreased hydrochloric acid secretion which prevents breakdown of some drugs, increased emulsifying content of the gut, and increased enzymes like γ-glutamyl transpeptidase which participate in active and passive transport of nutrients to the intestinal cells and (b) nonspecific mechanisms inhibiting enzymes participating in biotransformation of drugs, preventing their inactivation and elimination⁷⁴.

Pippali and Pippali Moola: Botanical Name - Piperlongum, English Name - Indian Long Piper

Chemical Composition⁷⁵: Essential oil, caryophyllene, mono and sesquiterpenes, piperine, piperlongumine, piperide, sesamin, piperonaline, piperundecalidine, β-sitosterol, four aristolactams (cepharanone B, aristolactum, All, piperlactum A and piperolactum B, five 4,5-dioxoaporphines etc.

Therapeutic Uses: Deepana (appetizer), Rechana (laxative), Rasayana (anabolic), Medhya (intellect promoting), Agnivaradhana (increases digestive power)⁷⁶.

Pharmacological Action:

Bio-Availability Enhancing Effect: Piperine, an active constituent of *Piper longum* enhanced the bio-availability of structurally and therapeutically diverse drugs. The mechanism of action may be by modulating membrane dynamics. The bioavailability enhancing effect of an ayurvedic compound (trikatu) containing *piper longum* as, one of the major ingredients, was examined with other drugs. The trial drug increased the bio-availability⁷⁷.

Piperine enhances the bioavailability and bio-efficacy of drugs by modulating drug metabolism. Also, it enhances the bioavailability and absorption of nutrients through its action gastrointestinal tract. Piperine has been shown to inhibit several cytochrome P450-mediated pathways and phase II reactions in animal models. Piperine, or mixtures containing piperine, has been shown to increase the bioavailability, blood levels, and efficacy of many drugs and nutraceuticals. Administration of piperine significantly increased plasma concentrations of rifampicin, phenytoin, spartein,

sulfadiazine, tetracycline, propranolol and theophylline in humans ⁷⁸.

Chavya: Botanical Name - Piperretrofractum, English Name - Piper stem

Chemical Composition ⁷⁹: Piperretrofractum has chemical constituents piperine, sitosterol, piplartine, amides-retrofractamide A, B, C, & D.

Therapeutic Uses: Deepana (appetizer), Pachana (digestive), Rochaka (appetizer), Krimi (antihelmenthic), Aanaha, Udarroganasaka (antispasmodic) ⁸⁰ Swasa, Kasa (cough), Atisara (diarrhea), Garavisa (antitoxic), Kshayanasaka (anabolic) ⁸¹.

Pharmacological Action:

Bioavailability Enhancing Effects: Piper retrofractum extract loaded nanostructured lipid carriers (PRE loaded NLCs) showed fast release characteristics and was effective against *Streptococcus mutans* and *S. sanguinis*. The mouth spray containing PRE-loaded NLCs exhibited good physical stability without particle aggregation. Furthermore, the chemical stability of piperine in NLCs was also significantly improved during storage at both storage conditions when compared to its solution form ⁸².

Tavaksheera (Vamshalochana): Botanical Name - *Bambusa arundinacea*, English Name - Bamboo manna

Chemical Compositions ⁸³: *Bambusa arundinacea* contains 0.25 to 3% of a volatile of aroma and protein, carbohydrates, magnesium, iron, calcium, phosphorus, chlorine, sodium, copper, thiamine and vitamin C etc.

Therapeutic Uses: Useful in Kshaya (emaciation), Jwara (fever), Kasa (cough), Raktapitta (haemorrhagic diseases), promotes Brmhana (weight gain) ⁸⁴ Ksayahara (checks emaciation), Svasahara (relieves dyspnoea), Balavardhaka (increases strength), Dhatuwardhaka (anabolic action) ⁸⁵.

Pharmacological Action:

Nutritional Effect: Bamboo seeds are nutrient-rich; the biological value of bamboo seed protein is comparable to that of rice proteins and higher than

wheat proteins. The composition of husked bamboo seeds in percentage are: moisture 10.0, ash 1.1, ether extractive 0.9, fibre 2.6, crude protein 12.0, carbohydrate 73.4, iron 9.2 mg %, calcium 25.0 mg %, phosphorus 218.0 mg %, carotene 12.0 µg % (20 International Units of Vitamin A), vitamin B1 0.1 mg (33.3 International Unit) %, riboflavin 36.3 µg %, Nicotinic acid 2.03 mg % and calorific value 98.0 (calorie per ounce).

The two-dimensional paper chromatographic study revealed that the bamboo seeds are comprised of all the essential amino acids. It is evident from the above results that ⁸⁶.

Shoots of *Bambusa arundinacea* contain 17 amino acids, 8 of which (serine, methionine, isoleucine, leucine, phenylalanine, lysine, and histidine) are essential for the human body ⁸⁷. Lysine is beneficial for a child's growth and development, and it lacks in cereals. Also, shoots have a good profile of minerals, consisting mainly of potassium (K), calcium (Ca), manganese, zinc, chromium, copper, iron (Fe), and lower amounts of phosphorus (P), and selenium ^{88, 89}. Further, the fresh shoots are a good source of thiamine, niacin, vitamin B6, vitamin A and vitamin E ^{90, 91}.

Anthelmintic Activity: Ethanolic extract of *Bambusa arundinacea* root was studied for its anthelmintic activity against *Pheritima posthuma*. Determination of paralysis time and death time of the worms was investigated in the different doses of the extracts viz. 10, 20 and 50 mg/ml.

The extract exhibited significant anthelmintic activity in a dose-dependent manner when compared to the control. The anthelmintic activity was comparable to that of Piperazine citrate (15 mg/ml) and Albendazole (10 mg/ml) (reference standard) ⁹².

Sveta Jeera: Botanical Name - *Cuminum cyminum*, English Name - Cumin seeds

Chemical Compositions ⁹³: *Cuminum cyminum* chemical constituents cuminin, diacyl glycerol, imperatorin, isoimperatorin, isoimpinellin, oxypeucedanin, apigenin and apin, oxalic, cuminaldehyde, p-cymene.

Therapeutic Uses: Rochaka (appetizer), Pachana (digestive), Balya (strength promoting), Medhya (intellect promoting)⁹⁴. Krimighana (anthelmintic)⁹⁵.

Pharmacological Action:

Drug Bioavailability Enhancing Activity: The aqueous extract of cumin seeds exhibited significant enhancement of rifampicin levels in rat plasma. This bio enhancing activity was due to the presence of a novel flavonoid glycoside in cumin, which increased the peak concentration (C_{max}) and AUC of rifampicin by 35 and 53%, respectively, when co-administered⁹⁶.

Immunomodulatory Effect: *Cuminum cyminum* was studied for its health modulating effects and immunomodulatory properties using flow cytometry and ELISA in normal and immune-suppressed animals. *Cuminum cyminum* stimulated the T cells and Th1 cytokines expression in normal animals. Swiss albino mice subjected to Cyclosporine-A induced immune suppression were dosed orally with *Cuminum cyminum* at 25, 50, 100, and 200 mg/kg on consecutive days. Results found that the administration of *C. cyminum* significantly increased T cells (CD4 and CD8) count and Th1 predominant immune response in a dose-dependent manner, suggesting immunomodulatory activity through modulation of T lymphocytes expression. Furthermore, *Cuminum cyminum* countered the depleted T lymphocytes, reduced the elevated corticosterone levels and size of adrenal glands, and increased the weight of thymus and spleen in restraint stress-induced immune-suppressed animals⁹⁷.

Gastrointestinal Effect: The antidiarrhoeal effect of aqueous extract of *Cuminum cyminum* seeds (ACCS) was investigated. The antidiarrhoeal effect was tested by castor oil-induced diarrhoea model, prostaglandin E2 (PGE2) induced enter polling model, and intestinal transit by charcoal meal test in albino rats. The ACCS exhibited a significant ($p < 0.001$) reduction in the frequency of diarrhoea, defecation time delaying, and secretion of intestinal fluid along with intestinal propulsion when compared to control (loperamide). The graded doses of the tested extract showed dose-dependent protection against diarrhea⁹⁸.

Ashwagandha: Botanical Name - Withaniasomnifera, English Name - Winter cherry.

Chemical Composition⁹⁹: Withaferin A, Withaone, Withanolide WS-1, Withanolide A to Y, Somnirol, Somnitol, Withasomniferin A, Nicotin, Tropine, Pseudotropine, Withasomnine, Sitoindosides VII-X, Solasodine, Sominolide, Sominolide.

Therapeutic Uses: Rasayana (rejuvenating), balya (strength promoting), brimhana (anabolic), sothahara (anti-inflammatory)¹⁰⁰.

Pharmacological Action:

Nutritional Effect: The nutrient content of dehydrated medicinal herbs powder Per 100 g Nutrient composition of Ashwagandha root powder (Per 100g) obtained by chemical analysis was found to be AS, Moisture 7.45%, Ash 4.41g, protein- 3.9g, Fat -0.3g, Crude Fiber - 32.3g, Energy -245 Kcal, Carbohydrate -49.9g, Iron -3.3 mg, the Calcium content -23 mg, Total carotene - 75.7 μ g and Vitamin C was 5.8 mg/ 100 g. Polyphenols content in Ashwagandha root powder was 19.80 mg, and the Free radical scavenging activity (DPPH) was observed to be 67.16%¹⁰¹.

Sharkara: Botanical Name - Saccharum Officinarum, English Name - Sugar-cane

Chemical Compositions¹⁰²: It contains sugar, water, resin, fat, albumin, guanine, and calcium oxalate.

Therapeutic Uses: Agnidipaka (appetizer), Balakaraka(strength promoting)¹⁰³.

TABLE 1: NUTRITIONAL VALUE OF SHARKARA PER 100 GM¹⁰⁴

Energy: 377kcal	Vitamins	Minerals
Carbohydrates: 97.33gm	Thiamine (B1) :0.008 mg	Calcium: 85 mg
Sugars: 96.21gm	Riboflavin (B2) : 0.007 mg	Iron: 1.91 mg
Fat : 0 gm	Niacin (B3) : 0.082 mg	Magnesium : 29 mg
Protein : 0 gm	Vitamin B6 : 0.026 mg	Phosphorus : 22 mg
Dietary fiber: 0 gm	Folate (B9) : 1 μ g	Potassium :133 mg

Goghrita: Latin Name- Butyrumdepartum, English Name-Clarified Butter

Chemical Compositions¹⁰⁵: Triglycerids: 97.98%, Diglycerids: 0.25-1.5%, Monoglycerides: 0.16-0.038%, Ketoacidglycerides: 0.015-0.018%. Glycerylesters: 0.011-0.015%, Free fatty acid: 0.1-0.44%, Phospholipids: 0.2-1%, Sterols: 0.22-0.4%.

Fat Soluble Vitamins: Vit A 2500 I.U./ 100 gm; Vit D 8.5×10.7 gm/ 100 gm; Vit E 24×10.3 gm/ 100 gm; Vit K 1.0×10.4 gm/ 100 gm.

Therapeutic Properties and Actions: Rasayana (rejuvenating),¹⁰⁶ Ojovardhak (immune enhancing), Tejobalakara (providing lusture),¹⁰⁷ Balya (strengthening),¹⁰⁸ Ayushya (longevity),¹⁰⁹ Medhya (intellect promoting),¹¹⁰ Deepana

(appetizer), Vriddhikar (growth-promoting), Vayasthapana (rejuvenating)¹¹¹.

Pharmacological Action: Cow's milk as a means to transfer immunogens or antigens is being utilized by rendering hyper-immune response by administering an appropriate agent.

In this hyper-immune state, the antigens find their way into the cow's milk, which, when administered to humans, especially children, render them immune to the particular disease. Cow's ghrita also has been seen to stimulate immune processes in experimental animals¹¹².

TABLE 2: THERAPEUTIC PROPERTIES AND PHARMACOLOGICAL ACTION OF CHATURJATADI SAMBHARAKA VALEHA

Drug	Therapeutic properties	Pharmacological action
Dalchini (<i>Cinnamomum zeylanicum</i>)	Deepana (appetizer), Pachana (digestive), Vatanulomana (carminative), Krimighana (antihelminthic) ⁶ Aamdoshanashaka (digestion of ama dosha) ⁷	Antimicrobial activity ⁸ , Gastroprotective activity ^{9, 10}
Ela (<i>Elettaria cardamomum</i>)	Rochaka (appetizer), Agnideepana (appetizer), Shwas (dyspnea), Kasa (cough), Kshayanashaka (anabolic) ¹¹	Transdermal Drug absorption enhancing effect ¹² Effect on Nausea and vomiting, ¹³⁻¹⁶ Nutritional effect ^{17, 20} . effect on digestive health ²¹
Tejpatra (<i>Cinnamomum tamal</i>)	Aruchi (anorexia), Hallasahara (nausea), ²³ Deepana (appetizer), Udarshool (abdominal colic), Atisaarnasaka (antidiarrheal) ²⁴	Anti-inflammatory effect ²⁵ antimicrobial activity, ^{26, 34} hepatoprotective action ³⁵ , antidiarrheal activity ³⁶
Nagkeshara (<i>Mesua ferrea</i>)	Deepana (appetizer), Pachana (digestive), Krimighana (antihelminthic), Balya (strength promoting) ³⁹	Anti inflammatory effect ^{40, 42} Immunomodulatory Effect ⁴³ Hepatoprotective effect ⁴⁴
Talishpatra (<i>Abbiswebbiana</i>)	Agnimandya (indigestion), Kshaya (emaciation), Chhardi (vomiting), Krimi (worm infestation), Aruchi (anorexia) Kasa (cough), Deepana (appetizer), Pachana (digestive), Balya (strength promoting) ^{47, 49}	Anti inflammatory activity ⁵⁰ Anti microbial activity ⁵¹
Kushtha (<i>Saussurealappa</i>)	Deepana (appetizer), pachana (digestive), upsargnashaka (anti infective), rasayana (rejuvenation) ⁵³ Kasa, shwas, shulaprashamana (analgesic), anulomana (carminative), daurbalya (used in weaness) ⁵⁴	Antidiarrheal effect ⁵⁵ , Effect on Gastric function ⁵⁶ , Antiparasitic effect ^{57, 58} .
Shunthi (<i>Zingiber officinalis</i>)	Anulomana (carminative), Deepana (appetizer), Amadosaghna (ameliorates amadosha), Pachana (digestive), Ruchya (palatable) ⁶⁰	Bioavailability enhancing effect ^{64, 65} .
Marich (<i>Piper nigrum</i>)	Deepana (appetizer), Svasahara, Sulaprashamana, Krimighna ⁶⁷ Ruchikaraka, Krimighna (antihelmenthic), Vamananashaka (antiemetic) ⁶⁸	Bioavailability enhancing Effect ^{69, 74} .
Pippali (<i>Piperlongum</i>), Pippalimula (<i>Piper longum</i>)	Deepana (appetizer), Rechana (laxative), Rasayana (anabolic), Medhya (intellect promoting), Agnivardhana (increases digestive power) ⁷⁶	Bioavailability enhancing effect ^{77, 78} .
Chavya (<i>Piper retrofractum</i>)	Deepana (appetizer), Pachana (digestive), Rochaka (appetizer), Krimi (antihelmenthic), Aanaha, Udarroganasaka (antispasmodic) ⁸⁰ Swasa, Kasa (cough), Atisara (diarrhea), Garavisa (antitoxic), Kshayanashaka (anabolic) ⁸¹	Bioavailability enhancing effect ⁸² .
Tavaksheera (<i>Bambusaarundinacea</i>)	Useful in Ksaya (emaciation), Jwara (fever), Kasa (cough), Raktapitta (haemorrhagic diseases), promotes Brmhana (weight gain) ⁸⁴ Ksayahara (checks emaciation), Svasahara	Nutritional effect ^{86, 91} . Anthelmintic activity ⁹² .

	(relieves dyspnoea), <i>Balavardhaka</i> (increases strength), <i>Dhatuwardhaka</i> (anabolic action) ⁸⁵	
Sveta Jeera (<i>Cuminum cyminum</i>)	<i>Rochaka</i> (appetizer), <i>Pachana</i> (digestive), <i>Balya</i> (strength promoting), <i>Medhya</i> (intellect promoting) ⁹⁴ . <i>Krimighana</i> (anthelmintic) ⁹⁵	Bioavailability enhancing effect, ⁹⁶ Immunomodulatory effect, ⁹⁷ Gastrointestinal effect ⁹⁸ Nutritional effect ¹⁰¹ .
Ashwagandha (<i>Withaniasomniferum</i>)	<i>Rasayana</i> (rejuvenating), <i>balya</i> (strength promoting), <i>brimhana</i> (anabolic), <i>sothahara</i> (anti-inflammatory) ¹⁰⁰ .	
Khand (Sharkara) (<i>Saccharum officinarum</i>)	<i>Agnidipaka</i> (appetizer), <i>Balakaraka</i> (strength promoting) ¹⁰³	High calorie, vit B1,B2, B3 B6, B9, Calcium, Magnesium, Phosphorus, Iron, Potassium 104.
GoGhrta (<i>Butyrumdepartum</i>)	<i>Rasayana</i> (rejuvenating), ¹⁰⁶ <i>Ojovardhak</i> (immune enhancing), <i>Tejobalakara</i> (providing lusture), ¹⁰⁷ <i>Balya</i> (strengthening), ¹⁰⁸ <i>Ayushya</i> (longivity) ¹⁰⁹ <i>Medhya</i> (intellect promoting), ¹¹⁰ <i>Deepana</i> (appetizer), <i>Vridhdhikar</i> (growth promoting), <i>Vayasthapan</i> (rejuvenating) ¹¹¹	Immunomodulatory action ¹¹² .

DISCUSSION: Although nutritional rehabilitation is the gold standard for the management of malnutrition, proper digestion and assimilation of nutrients are equally important. Also, worm infestations, frequent infections, gastrointestinal upsets, and inflammations are associated with malnutrition. Therefore along with nutritional rehabilitation, drugs having deepana (appetizer), pachana (digestive), anti-inflammatory, anthelmintic and, immune-enhancing, should also be included in the management of malnutrition to get optimum health. Ayurveda provides complete management in a single formulation to achieve a complete outcome.

CONCLUSION: In developing countries, malnutrition (balashosha) is a major problem in children. This problem is mainly related to improper uptake, digestion, and absorption of various Vitamins, Minerals, and trace elements in growing children. The present review reveals that the ingredients of Chaturjatadi Sambharak avaleha possesses immunomodulatory, antibacterial, antimicrobial, anthelmintic, and bioavailability enhancing action. Also, the ingredient has an effect on mild and moderate malnutrition due to their Deepana (appetizer), Pachana (digestive), Krimihara (anthelmintic) Balya (strength promoting), Brimhana (anabolic / growth-promoting), and Rasayana (rejuvenating) properties and has high nutritional value. Therefore, Chaturjatadi Sambharak can be an effective remedy for managing Malnutrition (Balashosha) in children.

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