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Review Article

MALNUTRITION-CHALLENGE IN 21ST CENTURY AND PROBABLE CONTRIBUTION OF AYURVEDA THROUGH MORINGA LEAVES

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ABSTRACT

Nutritive diet has grabbed the center stage in current times among common men as well as researchers & food has turned into a whole damn industry. Despite of everything, Malnutrition is the largest single contributor to diseases in the world & leads to 45% of all deaths in children under 5 in developing countries. Due to interrelated mother- child nutrition, if a breastfeeding mother gets required nutrition, her kid becomes healthy. The causes of improper nutrition are variable but lack of nutritious food combinations in all classes are most important throughout the world.

Ayurveda is science of individualistic need based dietetics & nutrition and describes foods accordingly. There is recommendation of a super food named *Shigru (Moringa)* for *Sutika* (lactating mothers) in Bhesajyaratnawali, taking this as reference we have conceptualized a food combination of Moringa +wheat flour+ jaggery which is super nutritious and serves as a cheap, affordable, easy to collect and easy to make, palatable preparation.

When 11% of the world's population is under nourished, need for such right food combination increases manifolds. Owing to per 100g nutritive value of these contents and their cost effectiveness, this combination has a potential to be a perfect staple dietary option for nutrition deficit individuals. It needs to be further established at large scale through RCTs so that large population can be benefitted.

INTRODUCTION

Nutrition through diets is different all over the world. It needs to be established what type and quantity of food people need. Research confirms that good nutrition in the early years or 1000 days from conception to child's 2nd birthday are crucial for human growth and mental development. For a child, a mother provides the foundation of health.^[2]

It starts from mother's womb and after that, breast feeding^[1] is the most important time in one's life. So nutrition of breastfeeding mother is most important. Women have unique nutritional requirements and in some cases need more nutrients than men, for example, women need twice as much calcium as men. During pregnancy and breastfeeding, women must ingest enough nutrients for themselves and their child, so they need

significantly more protein and calories during these periods, as well as more vitamins and minerals (especially iron, iodine, calcium, folic acid, and vitamins A, C, and K). But the scenario is more darker than it seems. Malnutrition has been found to affect three quarters of UK women aged 16-49 indicated by them having less folic acid than the WHO recommended levels. It is the plight of resourceful countries just imagine the conditions in developing countries. In fact, malnutrition is the largest single contributor to diseases in the world. Around 45% of all deaths in children under the age of 5 years in developing countries are linked to under nutrition.^[2]

Malnutrition

Malnutrition^[2] refers to deficiencies, excesses or imbalances in a person's intake of energy or nutrients. The term malnutrition covers 2 broad groups of conditions.

- One is under nutrition resulting from inadequate consumption, poor absorption, or excessive loss of nutrients -which includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals).
- The other is overweight, obesity and diet-related non-communicable diseases (such as heart disease, stroke, diabetes and cancer).^[2]

Malnourishment or malnutrition^[1]

Symptoms: Problems with physical or mental development, poor energy levels, hair loss, swollen legs and abdomen, irritability, diminished learning abilities, anemia.

Causes: Eating a diet in which nutrients are either not enough or are too much, malabsorption.

Risk factors: No breastfeeding, gastroenteritis, pneumonia, malaria, measles.

Prevention: Improving agricultural practices, reducing poverty, improving sanitation, empowerment of women.

Treatment: Improved nutrition, selection of right food combinations, supplementation, ready to use therapeutic foods, treating the underlying cause

Frequency: 821 million undernourished / 11% of the world population (2017-2018).

Deaths: 406,000 from nutritional deficiencies (2015).

Consequences of malnutrition^[1]

Disease and malnutrition are closely linked. Sometimes disease is the result of malnutrition, sometimes it is a contributing cause.

- In 2001, the FAO of the UN^[1] reported that iron deficiency afflicted 43 percent of women in developing countries and increased the risk of death during childbirth.
- There were 821 million undernourished people in the world in 2018 (10.8% of the total population). It showed an increase of about 36 million since 2015, when 10.6% were undernourished.
- In 2015, protein-energy malnutrition was estimated to have resulted in 323,000 deaths.
- 165 million children were estimated to have stunted growth from malnutrition in 2013.

- Other nutritional deficiencies, which include iodine deficiency and iron deficiency anemia, result in another 83,000 deaths.
- In 2010, malnutrition was the cause of 1.4% of all disability adjusted life years.
- In 2010, it was estimated to have contributed to about 1.5-3 million deaths in women and children.
- The prevalence of malnutrition in Indian children under 5yrs of age was more than 43% in 2006. A 2008 review of interventions estimated that universal supplementation with calcium, iron, and folic acid during pregnancy could prevent 105,000 maternal deaths (23.6 percent of all maternal deaths).
- A malnourished person finds that their body has difficulty doing normal things such as growing and resisting disease. Protein- Energy Malnutrition along with other Nutrients and Vitamins are major cause to initiate diseases and growth retardation.
- Pregnancy becomes risky and they cannot be sure of producing nourishing breast milk. Many families cannot afford or access enough nutritious foods like fresh fruit and vegetables, legumes, meat and milk and those who afford don't know the right combinations to eat.
- According to the World Health Organization, malnutrition is the biggest contributor to child mortality, present in half of all cases.
- In April 2016, the United Nations General Assembly adopted a resolution proclaiming the UN Decade of Action on Nutrition from 2016 to 2025.^[2] The aim is to ensure all people have access to healthier and more sustainable diets to eradicate all forms of malnutrition worldwide.
- Now the question comes that what is probable role of *Ayurveda* to help in reducing prevalence of Malnutrition?

Probable answer to malnutrition with the help of *Ayurveda*

Ayurveda is science of individualistic need based dietetics.

It has a very deep and detailed description of nutrition and food combinations according to the need of the persons. The malnutrition not only confines to poor people but it can also occur in higher society due to improper ways of eating and faulty intake of diet in respect of nutrients. Our scriptures very clearly mention food according to one's place, age, sex, bodytype, stage or physiological need and also according to type of food. Lactation is

the period of high energy demands. The substances mentioned as conducive or *Pathya* for *Sutika*^[3] must fulfill calorie demands. Our visionary seers were well aware of everything as described below:

सूतिकारोगमेपथ्य

दीपनपाचनमद्यपुराणाः शालिषटिकाः ।

कुलत्थोलशुनंशिशुवार्त्ताकुंबालमूलकम् ।।भैषज्यरत्नावली 69/127।।

There is recommendation of *Shigru* (Moringa), taking this as reference we have tried to conceptualize a supernutritious food combination of *Shigru* /moringa leaves +Jaggery + Wheat flour (baked/roasted) in different proportions according to need of energy, protein, nutrients and vitamins as per age, gender and physiology.

How it will work? We need to explore these *Aahar Dravya* in details.

Shobhanjan Patra^[4-7] (leaf of *Moringa oleifera*)

Shigru is a basic native of India and found in Sub-Himalayas. The scientific name is *Moringa oleifera* and *Shigru*, *Shobhanjana*, drumstick are the synonyms. Parts used are roots, bark, leaves, pods, flowers and fruits. It grows in tropical, subtropical and semi-arid climate. It is used in traditional Indian medicine for centuries. Due to its nutritional and medical properties it is known as “miracle plant”.^[4]

It is very nutritious so used as a food source in many countries. Its leaf has 15 times more Potassium than Banana and 17 times more Calcium than Milk, 9 times more Protein than Yogurt, 10 times more Vit.A than Carrot, 7 times more Vit.C than oranges, 25 times more Iron than Spinach in per 100gms each. It is rich in essential amino acids which are present in animal origin protein.^[5] *Shobhanjan Patra* are completely safe for human consumption. There are not any toxic elements present or side effects seen. The leaves have flavonoids (antioxidants necessary for the fight against free radicals that are causing all sorts of problems in the human body)^[6]. We know its many traditional uses to cure diseases and also provide help to minimize lack in many nutritional supplements such as protein, minerals, and vitamins.

Nutritional variation may be present due to genetic background, environmental conditions and adopting cultivation.

Nutrient comparisons per 100 gms^[6,7]

Nutrients	Common Food	Dried Leaves of <i>Shobhanjan</i>
Vitamin A	Carrot 1.8mg	18.9mg
Vitamin C	Oranges 30mg	17.3mg
Calcium	Milk 120mg	2003mg
Potassium	Bananas 88mg	1324mg
Protein	Yogurt 3.1gm	27.1mg
Iron	spinach 2.7 mg	28.2mg

For a child aged 1-3yrs, a 100 grams serving of fresh leaves would provide all his daily requirements of calcium & iron and nearly half of protein needs as well as important amounts of potassium, B vitamins, copper and all the essential amino acids.^[6] As little as 20 grams of leaves would provide a child with all the vitamins A and C he needs.^[7]

For pregnant and breast-feeding women, *Moringa* leaves and pods can do much to preserve the mother's health and pass on strength to the fetus or nursing child. One 100 g portion of fresh leaves could provide a woman with over a third of her daily need of calcium and give her important quantities of iron, protein, copper, sulphur and B-vitamins.^[6] During pregnancy and breast-feeding, women are most at risk of suffering from nutritional deficiencies. Two studies conducted in Phillipines showed *Moringa* leaves act as galactagogue in preterm mothers and had no side effects in nursing mothers.^[14,15] Only 6 spoonfuls of *Moringa* powder may satisfy a woman's need of iron and calcium during pregnancy and breastfeeding.^[4]

Analytical values of *Shigru* dry leaf powder per 100 grams^[6]

Moisture (%)	7.5	Fe (mg)	28.2
Calories	205cal	S (mg)	870
Protein (g)	27.1	Cu (mg)	0.57
Fat (g)	2.3	Vit.A (mg)	18.9
Carbohydrate (g)	28.2	Vit.B1 (mg)	2.64
Fiber (g)	19.2	Vit.B2 (mg)	20.5
Ca (mg)	2003	Vit. B3 (mg)	8.2
Mg (mg)	368	Vit.C (mg)	17.3
P (mg)	204	Vit. E (mg)	113
K (mg)	1324	Oxalic Acid (mg)	1.6

The amino acids profile of the leaf of *Shigru* (in g/100g protein)^[8]

Glycine	:	5.15
Alanine	:	3.43
Serine	:	4.20
Valine	:	3.36
Threonine	:	4.38
Isoleucine	:	2.33
Aspartate	:	6.86
Lysine	:	3.60
Glutamate	:	15.14
Methionine	:	0.95
Phenylalanine	:	4.26
Histidine	:	1.90
Arginine	:	1.88
Leucine	:	5.22
Tyrosine	:	2.20
Cysteine	:	2.05

Essential amino scores* of the leaf of *M. Oleifera* based on the W.H.O reference pattern^[8]

Amino acid	RP**	Leaf (%)
Lysine	5.17	69.66
Histidine	1.77	106.76
Threonine	3.47	126.20
Valine	4.81	69.81

Amino acid	RP**	Leaf (%)
Methionine	1.53	62.09
Isoleucine	4.19	55.59***
Leucine	7.03	74.30
Phenylalanine	3.01	141.41

* Reference pattern in g/100g protein.

** Amino acid scores = $[\text{g}/100\text{g of amino acid in sample} \div (\text{g}/100\text{g of amino acid in reference protein})] \times 100$.

*** Limiting amino acid.

Benefits of *Shigru* leaves

- The leaf has 90 nutrients, 46 antioxidants, 36 anti-inflammatory, 20 amino acids in which 8 essential amino acids nourish the immune system.^[6]
- Promotes healthy circulation^[8]
- Supports normal Glucose levels^[8]
- Natural Anti-aging benefits^[8]

- Provides Anti-Inflammatory support^[8]
- Promotes healthy digestion^[8]
- Promotes heightened mental clarity^[8]
- Boosts energy without Caffeine^[8]
- Encourages balanced metabolism^[8]
- Promotes softer skin, provides relief from Acne^[8]
- Supports normal hormone levels.^[8]
- The leaves are outstanding as a source of Vitamin A and Vitamin C. They are a good source of B Vitamins also.^[6]
- The leaves are the best plant sources of minerals. The calcium content is very high for a plant. Phosphorus is low, as it should be. The content of iron is very good & can be prescribed for anemia. They are an excellent source of protein and a very low source of fat and carbohydrates. Thus the leaves are one of the best plant foods that can be found cheaply in most part of Indian population.^[8]
- Protein and aminoacids are the building blocks of body. Due to high protein content Moringa leaves are excellent for muscle gain. ^[9]
- Due to high mineral and iron source, it is very helpful in treating anaemia. ^[9]
- Due to high carotenoid content, is very good for eyes and vision. ^[9]
- Calcium content is also very rich in Shigru/*Moringa* so it serve as good food for bone and teeth health. ^[9]

Jaggery^[10]

Jaggery or Guda - It is used since ancient time for medicinal and nutritional purpose in India. Jaggery, also called Gur (*Guda*), is traditional form of raw sugar or unrefined sugar derived from sugarcane juice. Jaggery is less processed and prepared in natural way similar to our cooking method for various foods. Jaggery making is a simple process, so it is free from many harmful chemical processing.^[10]

It is dark yellow or brown in color and a great substitute to chemically processed or centrifugal sugar. It is widely used in India, Myanmar and some other Asian and African countries.^[10]

Nutritional value per 100 gm^[10]

It contains more nutrients than refined sugar due to its molasses content. Refined sugar contains only empty calories i.e. calories without vitamins and minerals.

Sucrose	-	85gms
Fructose and glucose	-	10-15gms
Proteins	-	0.4gms
Fat	-	0.1gms
Iron	-	11mg or 61% of RDI
Magnesium	-	70-80mg or 20% of RDI
Potassium	-	1050mg or 30% of RDI
Manganese	-	0.2-0.5mg or 10-20% of RDI
Calories	-	383

It also contains traces of Vit B12 & other minerals including calcium, zinc, phosphorus and copper.

Benefits related to nutrition-

प्रभूतक्रिमिज्जासृद्धमेदोमांसकरो गुडः।।(च. सू. 27/238)।।^[11]

Jaggery is said to nourish body by increase *Dhatus* viz. *Rakt, Mansa, Meda* and *Majja*.^[11]

- General debility or physical weakness- Jaggery is a healthy sugar, which also provides instant energy to the body. In general debility, it can be used with milk. Jaggery and milk combination has strengthening effects in the body. Thus, it can help reducing physical weakness and provides energy.^[10]
- Improves immunity-Jaggery contains minerals such as zinc and selenium. These minerals are known for their anti-oxidant properties so it can assist the body to fight off infections.^[10]
- Jaggery is a good source of iron, so it helps in anemia.^[10]
- Improves appetite and digestion-Jaggery has digestive stimulant property which helps in improving digestion and appetite. It gives strength to intestines and relieves constipation.^[10]
- Jaggery also reduces anxiety and mood swings. This effect might be due to the release of endorphins after eating jaggery.^[10]

It is cheaper than sugar and most of the poor population can afford it.

Wheat^[12]

The most widely grown common wheat is *Triticumaestivum*. It is grown on more land area than any other food crop (220.4million hectares area) in the world and 2nd most produced cereal after maize. Wheat is one of the most widely eaten cereal as staple food.

Consumed worldwide by billions of people, wheat is a significant food for human nutrition, particularly in the least developed countries where wheat

products are primary foods. When eaten as the whole grain, wheat is a healthy food source of carbohydrates, proteins, multiple nutrients and dietary fibers recommended for children and adults in several daily servings containing a variety of foods that meet whole grain-rich criteria.^[12]

Nutrition per 100 g^[12]

Energy	-	1,368 kJ (327 kcal)
Carbohydrates	-	71.18 g
Sugars	-	0.41
Dietary fiber	-	12.2 g
Fat	-	1.54 g
Protein	-	12.61

Vitamins	% DV	Quantity [mg]
Thiamine (B1)	33%	0.383mg
Riboflavin	10%	0.115 mg
Niacin (B3)	36%	5.464 mg
Pantothenic Acid(B5)	19%	0.954 mg
VitaminB6	23%	0.3 mg
Folate(B9)	10%	38 µg
Choline	6%	1.2 mg
Vitamin E	7%	1.01 mg
Vitamin K	2%	1.9 µg

Minerals	%DV	Quantity [mg]
Calcium	3%	29 mg
Iron	25%	3.19 mg
Magnesium	35%	126 mg
Manganese	190%	3.985 mg
Phosphorus	41%	288 mg
Potassium	8%	363 mg
Sodium	0%	2 mg

µg = micrograms • mg = milligrams

IU = International units

Source: USDA Nutrient Database

Nutritional benefits from Wheat

सन्धानकृद्वातहरोगोधूमः स्वादुशीतलः।जीवनोबृंहणो दृष्यः स्निग्धः स्थायिकरोगुरुः।।(च. सू. 27/21)^[13]

- It is said to provide nourishment, strength, vital for life, and aphrodisiac in *Ayurveda*.^[13]
- It is the chief source of vegetable protein and most widely used cereal all over the world.^[12]

- In 100 grams, wheat provides 1,370 kilojoules (327 kilocalories) of food energy and is a rich source (20% or more of the Daily Value, DV) of multiple essential nutrients (table).^[12]
- Several B vitamins and other dietary minerals are in significant content. Wheat is 13% water, 71% carbohydrates, 1.5% fat and 13% protein, iron is 25% and calcium is 3%.^[12]
- Raw wheat can be ground into flour & semolina, germinated and dried creating malt, crushed or cut into cracked wheat; parboiled (or steamed), dried, crushed and de-branned into groats. If the raw wheat is broken into parts at the mill, as is usually done, the outer husk or bran can be used in several ways.^[12]
- Wheat is a major ingredient in such foods as bread, porridge, crackers, biscuits, muesli, pancakes, pasta and noodles, pies, pastries, pizza, polenta and semolina, cakes, cookies, muffins, rolls, doughnuts, gravy, beer, vodka, boza (a fermented beverage), and breakfast cereals.^[12]
- They can be used either as a major food or snacks as per choice.
- Their combination can be made easily with minimum efforts and infrastructure.
- No techniques are needed to be learnt to prepare this food item so any person irrespective of health status, education and background can make it at home.
- It requires very less time for preparation so can serve as a instant healthy food in this busy life.
- Nutrition starts from kitchen so a homemade super food can be the best thing one can have as a staple diet.

CONCLUSION

In this decade of fighting malnutrition [2016-2025] as adopted by WHO, we need to discover more such food combinations which can be made by all and can be afforded by all. Malnutrition is a serious challenge even in this era of technological and nuclear advancement because human body is run by nutrition and a healthy mind needs healthy body which inturn needs healthy diet.

Progress is genuine when basic needs of mankind are catered easily. True development lies in healthy & happy faces not in the heaps of technological advancements.

This concept is a very small effort to contribute in the staple diet chart of majority and it needs clinical trials, estimation of complete nutritional values with standard combinations, ratio and assessment of economy of product so that large scale utility of this can be appreciated.

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Preparation and Doses

Take dried leaves of *Shigru* and powder them. Roast whole wheat flour in Iron pan on low heat and mix Jaggery in it according to need of calories. When temperature of mixture is reduced up to warm level then mix *Shigru* leaves powder in it.To make it palatable, the various preparations can be made like *Modak*, *chikki*, *biscuit*, *Lapsika*. To make it more calorie dense, dry fruits and ghee can be added if affordable. The dose and the ratio of this combination depends upon needs of person who is taking. So it depends upon the wisdom of clinician.

DISCUSSION

All three ingredients of this combination are powerhouse of nutrition, cheap, affordable, easily available and can be advised to anyone who is suffering from malnutrition directly or after a chronic debilitating disease.

- *Moringa* leaves retain the nutrients even after drying so can be used for long time and can be transported to places of non-availability.
- Keeping in view, the easy cultivation, nutrition values, medicinal properties, sustainability of nutrients after drying, usefulness of every part, this plant is truly wonderful which can ease out the burden of malnutrition over economy as well as society.
- Whole wheat is 2nd most used cereal all over the world so familiar and easily available to all.
- Jaggery adds taste, nutrients as well as palatability to the preparation and fulfill extra demand of carbohydrate and energy.

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