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Rice – A Nutraceutical

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Abstract

Rice is known as the grain of life, and is synonymous with food for Asians. In addition to being a staple food and an integral part of social rites, rituals, and festivals in almost all Asian countries, it has a medicinal value too, which was clearly recognized by the medicine systems of the region centuries ago. Rice is the main constituent of life-saving oral rehydration solutions (ORS), and has been used for this purpose since time immemorial. Ancient Ayurvedic treatises laud the Raktashali red rice as a nutritive food and medicine. The medicinal value of other rices such as Sashtika, Sali, and parched rice have been documented in the Charaka Samhita (c. 700 BC) and the Susruta Samhita (c. 400 BC), in the treatment of various ailments such as diarrhea, vomiting, fever, hemorrhage, chest pain, wounds, and burns. Even today, certain varieties with medicinal value are used in Karnataka, Madhya Pradesh, Kerala, Tamil Nadu, Uttar Pradesh, the Western Ghats, and Himachal Pradesh to treat skin diseases, blood pressure, fever, paralysis, rheumatism, and leucorrhea, as well as a health tonic and for lactation. The famous Nivara rice of Kerala is widely employed in Ayurvedic practice as a body enriching item, to exclude toxins and delay premature ageing. Colored rices (black and red) are rich in minerals (iron and zinc) and polyphenols and have antioxidant properties. Traditional varieties such as basmati have a low glycemic index and are useful in weight-reducing diets. Rice-based ORS is reported to be better than glucose-based ORS, and has been included in WHO (World Health Organization) recommendations. Indian medicinal rice varieties need to be clinically validated. More importantly, efforts must be made to conserve such varieties, through public awareness programs and aggressive marketing.

The last 20 years have witnessed a major change in the disease pattern in India, which clearly follows a generalized global trend. The shift from communicable diseases to lifestyle-related diseases is apparent not only in urban India, but in rural India too. Lifestyle-related diseases such as heart attack, diabetes, and cancer have begun to assume epidemic form over the last two decades, with experts attributing it to bad genes. International studies have shattered this myth, putting the blame on sloppy lifestyles, faulty diets, and high stress levels.

Over the last decade, globalization and rampant consumerism have triggered a flood of culinary ideas from all parts of the world, resulting in a never-before platter of gourmet delights. While this has satisfied the taste buds of Indian consumers, it has also brought in its wake a disturbing increase in lifestyle-related diseases. The alarm bells have already started ringing for diabetes and heart problems. Newly developed medicines are costly, have side effects, and burden the state exchequer. Lifestyle-related diseases therefore represent a serious problem that is expensive to control, apart from the heavy out-of-pocket-expenditure burden on the common man.

Indian nutritionists have often raised a hue and cry against the growing public inclination towards junk food, and have been constantly recommending the use of green, healthy, and functional food. A number of advertisements nowadays promote wheat flour (*atta*) noodles and brown wheat bread in the place of *maida* (white refined flour) bread. Extensive studies are being made to find novel food-based approaches

to lowering the incidence and severity of lifestyle-related diseases. The focus is on mineral contents, antioxidant properties, and the glycemic index of food. Against this backdrop, rice (*Oryza sativa*) holds promise as a medicinal and health food.

Many Europeans have observed the effect of rice on the human body, though rice is not their staple food. The French traveler and diamond merchant, Jean-Baptiste Tavernier, who visited India in 1646, observed that wheat-eating people had more strength while rice eaters had more stamina. These observations were based on laborers working at the Madras harbor who were mostly eating red coarse rice (Ball, 1995; Vir *et al.*, 2005). In 1938, the *Rice Journal* recorded similar observations in America. Commenting on rice eaters, the editor of the journal recorded that the Japanese and Chinese respectively can consume over 233 and 400 pounds of rice/person/year. Both these sturdy races are fighting a devastating war with rice as the main 'belly timber'. He also speculated, "Maybe our people would have better health and more energy if they ate more rice" (Anonymous, 1997).

Rice is the second most widely consumed cereal in the world next to wheat. It is the staple food for two-thirds of the world's population. Over 2 billion people in Asia alone derive 80% of their energy needs from rice, which contains 80% carbohydrates, 7–8% protein, 3% fat, and 3% fiber (Juliano, 1985). Until recently, rice was considered only a starchy food and a source of carbohydrates and some amount of protein. Rice protein, though small in amount, is of high nutritional value (Chaudhary and Tran, 2001). Recent studies have unraveled a number of unknown properties of rice, some of which have been reported in ancient Indian Ayurvedic literature.

The ancient literatures of rice-growing Asian countries such as Thailand, Myanmar, China, Malaysia, Indonesia, and India have attributed some medicinal properties to rice, in addition to it being the mainstay as food. In early oriental writings, whole brown rice was mentioned as the perfect food. In China, the medicinal value of rice was known as far back as in 2,800 BC, when it was used by royal Chinese physicians for healing purposes. It was believed to restore tranquility and peace to those who were easily upset. Dried, sprouted rice grains were used to aid in digestion, toning muscles and expel gas from the stomach and intestines. The Chinese believe rice strengthens the spleen as well as stomach, increases appetite, and cures indigestion. They use red rice yeast for various ailments.

Traditional Malaysian medical writings prescribe boiled rice 'greens' as an eye lotion and for use in acute inflammation of the inner body tissues. The application of dried powdered rice is recommended for skin ailments. In Cambodia, the hulls of mature plants are considered useful for treating dysentery. Hulls of three-month-old rice plants are diuretic. In the Philippines, rice polish (bran, *tiki tiki*) is extracted and used as an excellent source of vitamin B to prevent and cure beri-beri (Vir *et al.*, 2005).

In India, rice has enjoyed a unique status since ancient times because of its special qualities. Ancient Indian texts and folklore contain references to the special properties of rice. The great sage Parashara in the Sanskrit text *Krishi-Parashara* has aptly written in praise of this foodgrain: "Rice is vitality, rice is vigor too, and rice indeed is the means of fulfillment of all ends in life. All, Gods, demons, and human beings subsist on rice" (Majumdar and Banerji, 1960). Nobody could have expressed reverence to rice in a better way than sage Parashara.

In India, the medicinal value of rice has been as known to common people as to traditional physicians, which is evident from references to it in the following Telugu folk song (Raju, 1984):

Oppula kuppaa, oyyari bhaama
Sanna biyyam, chaaya pappu
Minapaa pappu, merika biyyam
Paalu neyyi, payasam vandu
Nee magadu thinte, aanandamante.

[O girl of infinite charms! O girl of personified beauty!
Take superfine rice, bleached pulses, and black gram dhal
Cook them with ghee and milk
If it is fed to your husband, you will enjoy life.]

Medicinal uses of rice

Rice is the only cereal that is eaten as a whole grain, and according to Ayurvedic concepts, the whole grain is more easily digested than flour (Ahuja *et al.*, 1995). It is considered the best as food among all cereals. This quality has been lauded by various authors such as Charaka, Susruta, Kautilya, Varahamihira, and Panini in their respective treatises. The Ayurvedic treatises of Charaka (c. 700 BC) and Susruta (c. 400 BC) discuss rice under the cereals section of food articles. Charaka listed a number of rice groups that were grown and matured in different seasons, along with their influence on the human body and physiology. Susruta elaborated the properties of various varieties of rice grown under different conditions. Later, the *Bhavaprakash Nighantu* added more information in the context of human health. No other cereal, including wheat, has received so much attention in these treatises (Nene, 2005).

Ayurveda envisages that all living organisms are evolved from the five elements – ether, wind, fire, water, and earth. The three humors – *vata* (wind), *pitta* (bile), and *kapha* (phlegm) – are also evolved from the five elements, but are manifested only in the four life forms: human and animals; serpents and birds; insects and pests; and plants and trees. The equilibrium of these three humors in a living organism translates into health, which is the fundamental principal of Ayurveda. In the equilibrium state, the three humors are called *dhatu*s (from the Sanskrit root *dha*, ‘to sustain’), because they sustain the body. When the equilibrium is disturbed, disease occurs. In this state, the *dhatu*s are called *dosh*as. Treatment therefore mainly consists in administering substances with properties opposite to the respective vitiated *dosh*a, in order to reinstate the normal equilibrium (Sadhale and Dave, 2006).

According to Ayurvedic treatises, rice can alleviate or subdue the *tridoshas* (humors) – *vata*, *pitta*, and *kapha* – whose imbalance in the human body causes various types of diseases. In addition to its ability to remedy such imbalances, rice possesses the rare capability to enrich body elements, exclude toxic metabolites, strengthen, revitalize, and energize the body, regulate blood pressure, prevent skin diseases and premature ageing.

Different groups of rice affect the human body differently, as they possess different inherent qualities to alleviate the three *dosh*as. Even today, Ayurvedic practitioners prescribe different rices for various ailments (Table 1). The *vaid*s (traditional doctors) of yore possessed profound knowledge of the different effects of rices, and were very particular in their prescription (Watt, 1891).

Ayurveda identified rice groups according to the growing seasons: transplanted rice was referred to as *Sali* (July to November–December); broadcasted rice as *Vrihi*; and summer rice maturing in 60 days was called *Sashtika* (Kumar, 1988). All types of rices – short, long, white, red, and black rice – are known to possess medicinal properties.

Varieties of *Sali* were considered sweet in taste, cooling in potency, light in digestion, and capable of imparting strength (Table 2). They were supposed to subdue *pitta*, and slightly increased *vata* and *kapha*. Of these, *Red Sali* (*Raktasali*) was the most efficacious in subduing deranged humors. It was considered diuretic, spermatophytic, refrigerant, eye-invigorating, cosmetic, tonic, and pleasant. It was good for fevers and ulcers, and was antitoxic. Other species of *Sali* were considered slightly inferior.

The *Vrihi* varieties were described as sweet and astringent, and hot in potency. They were supposed to increase the secretions of internal organs, and bring on constipation of the bowels. The *Krishna Vrihi* (black) was considered the best among the *Vrihi* group.

Table 1. Uses of rice groups and forms in various ailments.¹

Type of rice	Uses
<i>Sali</i> rice	Rasayana therapy: Roots of <i>Sali</i> rice used as a component of <i>Brahma rasayana</i> Piles: <i>Sali</i> and <i>Sashtika</i> rice along with butter, ghee, goat meat, and fresh wine checks bleeding from hemorrhoids Burns: After cleaning the affected area, <i>Sali</i> rice mixed with ghee is applied Anemia: <i>Sali</i> with barley Fractures: Application of a paste of <i>Sali</i> rice with ghee Meno-metrorrhagia: Powder of <i>Red Sali</i> in milk and honey Milk increase: Powder of <i>Sali</i> with milk Chest pain: Liquid gruel of <i>Red Sali</i> for pain in the chest, pelvis, and head
<i>Sashtika</i> rice	During rasayana therapy, <i>Sashtika</i> rice should be taken with ghee, or with milk mixed with ghee As aphrodisiac: <i>Satikadi Brahmi gutika</i> contains <i>Sashtika</i> as the main component Premeha: Diet of <i>Sashtika</i> and barley Udara: To treat stomach problems, gruel prepared from <i>Sashtika</i> soaked in cow urine and taken with milk
<i>Laja</i> rice	Fever: Saturated drink of <i>Laja</i> rice with sugar and honey for burning sensation, vomiting, debility, and thirst Diarrhea: Pieces of <i>kosakar</i> , a type of sugarcane, fried in ghee and mixed with sugar and honey to be taken with powdered <i>Laja</i> rice Vomiting: Powdered <i>Laja</i> rice with honey and ghee Intrinsic hemorrhage: Saturated drink of <i>Laja</i> powder with ghee and honey
<i>Nivara</i> rice	Oil: Used in the treatment of cervical spondylitis, low backache, paralysis, rheumatoid arthritis, and neuro-muscular disorders Weaning food for underweight babies Stomach ulcers: <i>Nivara</i> flour with banana Psoriasis and skin lesions: <i>Nivara</i> paste applied Snakebite: Paste used to reduce pain General health, body weight, and expectant mothers: <i>Nivara</i> gruel with meat Polio: Coconut, gingelly (sesame) oil, and <i>Nivara</i> paste is rubbed over the affected organs Hemorrhoids: Raw rice wetted in milk and roasted in cow milk taken for 21 days As aphrodisiac: Rice flakes with <i>asvagandha</i> (<i>Withania somnifera</i>) and sugar Urinary complaints: Decoction prepared from roots of <i>Nivara</i> given to children
1.	Source: Sharma (1996).

Sashtika rices were described as sweet in taste, pacifying *vata* and *kapha*. Although it left an astringent taste, it was considered the most efficacious of the rices. *Sashtika* rices were considered light, mild, demulcent, and imparting strength to the body.

Among wild rices, *Nivara* was considered the best, and was described as being able to generate heat, with a sweet and astringent taste. It could subdue *kapha* and had curative properties.

Table 2. Properties of various rice groups identified in Ayurveda.

Type of rice	<i>Rasa</i>	<i>Veerya</i>	<i>Guna</i>	Decreases	Increases
<i>Sali</i>	Sweet	Cool	<i>Laghu</i> (light)	<i>Pitta</i>	<i>Vata, kapha</i>
<i>Vrihi</i>		Hot			Secretion of internal organs
<i>Sashtika</i>	Sweet	Cool			
<i>Laghu</i> (light)		<i>Vata, kapha</i>			
<i>Nivara</i>	Sweet/astringent	Hot		<i>Kapha</i>	

Influence of agronomic practices on medicinal properties

In addition to varietal differences, and growing seasons, rices were traditionally classified according to growing areas, soil types (marshy or dry soils), land preparation (plowed or unplowed land), planting method (broadcast or transplanted), ratoon or volunteer crop, and ageing of rice (new or one/two-year-old rice).

Transplanted rices were considered better, and the rice obtained from once-transplanted paddy and from paddy transplanted several times in succession were described by Susruta as easily digestible and effectively more nutritious (Nene, 2005; Ahuja and Ahuja, 2007). Ayurvedic treatises document the properties of different varieties, grown in different seasons and areas, and on various soil types. The ancient works also record their effects on human physiology (Table 3).

Table 3. Ayurvedic properties of different rices, and their effect on human physiology.

Type of rice	Ayurvedic property/Effect on human physiology
Rice maturing in October	Oily, constipating, tasty, voice improving, virility and blood enhancer, slightly flatulent, cough producing, refrigerant, acidity reducer, diuretic
Produced in parched or burned soil	Digestible, laxative, diuretic, cough reducer
Rice produced in plowed land	Less flatulent, acidity and virility enhancer, constipating, memory and physical strength enhancer
Rice grown in dry regions	Astringent, pungent, slightly bitter and sweet, pacifies <i>kapha</i> and <i>pitta</i> , increases <i>vata</i> and digestive fire
Rice grown in marshy land	Sweet, aphrodisiac, strength promoting, <i>pitta</i> -pacifying, reduces quantity of feces, increases <i>kapha</i> and semen
Volunteer rice	Tasty, acrid taste, reduces acidity, cough and appetite enhancer, flatulent
Ratoon rice	Parching, suppresses evacuation of stool
Transplanted rice	Easily digested, semen enhancer
Once or transplanted many times	Easily digested, light, nutritious, diuretic
New rice	Increases secretions of internal organs
Old rice (one year maturity)	Light
Two-year-old rice	Excellent in quality
<i>Raktasali</i> (red rice)	Improves eyesight, best for health, good for skin, diuretic, voice improver, semen enhancer

Medicinal value of rices processed in different ways

Ancient Ayurvedic and agricultural treatises also describe the effect of food/rice processing on the human body. The influence of prepared/processed forms is reported to be different than that of raw rice. *Red Sali* rice is *laghu* (light) in *guna* but turns *guru* (heavy) after being roasted and flattened. That is, it takes more time to get digested and tends to increase body fats. Similarly *Sali* is *laghu* and becomes *guru* (heavier than even wheat) after roasting. *Vrihi* rice is *guru* in *guna* and causes *pitta*, but when parched it is *laghu* and *pichhal* (slimy). Four kinds of starchy preparations are made from rice on boiling. These are differentiated on the basis of the relative proportion of liquid and solids. *Maand* contains only liquid and no solids; *peya* has a higher liquid content; *vilepi* contains a higher solid proportion in comparison with *peya*; and *odana* is entirely solid. *Maand*, *peya*, *vilepi*, and *odana* are *laghu* in *guna*, with *maand* being the most *laghu*, and *odana* the least. *Maand* is used as *anupan* with various medicines; it is the easiest to digest and does not increase fat in body.

The food quality of rice has also been discussed in some old cookery books. The *Bhojana-kuthuhala* is a Sanskrit treatise on the art of cookery written by Sri Raghunatha Suri (17th century AD), a close associate of Swami Ramadas, the Guru of Chatrapati Shivaji, the well-known Maratha ruler. This treatise elaborates the Ayurvedic properties of rice varieties such as *Rajanam*, *Krishnasali*, *Red Sali*, *Red Sambha*, *Munda Sali*, *Mahasali*, *Sugandha Sali*, *Thriya Sali*, *Sashtika*, and *White Sambha*. Of these, *Krishnasali*, *Red Sali*, *Munda Sali*, *Mahasali*, *Sugandha Sali* (as *Sugandhaka*) and *Sashtika* (Table 4) are mentioned in various treatises earlier (Vijayalakshmi and Sunder, 1994).

Common medicinal uses in India

In pre-independent India, rice was often used as medicine. The simplest use of rice was as gruel in cases of diarrhea. Various other forms as flour, paste, *laja* (parched rice), boiled, flattened, fried rice, and dried, sprouted seedlings were also used for medicinal purposes to treat various diseases. Fried rice was considered light, suited to invalids and dyspeptics. Flattened rice with curd was often given in dysentery.

Rice was used as an article of diet for the sick and convalescing, and was of less aperient quality than any other grain. For this reason, several Sanskrit medical authors (such as UC Dutt, Hindu Materia Medica), invariably prescribed rice, usually in the form of gruel, as the safest and the best food in all dysenteric complaints. Indian pharmacopoeia recommended rice-water as an excellent demulcent and refrigerant drink in febrile and inflammatory diseases and dysuria. It was rendered more palatable, acidulated with lime-juice and sweetened with sugar. This decoction was recommended as enema for bowel-related problems. In the Delhi region, rice was used as an astringent drink in cholera and dysentery (Watt, 1891).

In addition to being the preferred diet for the sick, rice being wholesome and light is considered as the best food in some diseases. For example, in diarrhea, when the Ayurvedic preparation *Dugdhavati* is prescribed, boiled rice and milk is the *pathya* (wholesome food recommended for the patient).

Sexual tonic and Indian ‘Viagra’

Two of the ten formulations listed in the Brihat Samhita for treating sexual disorders use *Sashtika* rice as one of the ingredients. The first formulation describes an evening meal consisting of boiled *Sashtika* rice taken with clarified butter and black gram soup, and milk to be taken thereafter. Another formulation recommends cakes made from a compound of sesame seeds, roots of *asvagandha* (*Withania somnifera*) and *kapikacchu* (*atmagupta*, horse-eye bean, *Mucuna pruriens*), *vidarika* (*Ipomoea mauritiana*), and the flour of *Sashtika* rice ground in goat’s milk and fried in clarified butter.

Burton and Arbuthnot (1977) mention a remedy given in Kalyan Malla's *Ananga Ranga*: "Take 12 *mashas* each of seeds of white *tal-makhana* (*Hygrophila auriculata*) and *devabhat* (wild rice growing near tanks and swamps), mix with an equal weight of honey and eat at night. The patient though smitten with years will gain enormous vigor ..."

Table 4. Properties of rice varieties mentioned in the *Bhojana-kuthuhala*.¹

Variety	Rasa	Increases	Decreases	Specific property	General property
<i>Rajanam</i>	Sweet	–	Reduces all three <i>doshas</i>	Enhances digestive fire	Increases appetite and strength
<i>Krishna Sali</i>	Sweet		Reduces all three <i>doshas</i>	Enhances digestive fire	Increases strength and virility
<i>Red Samba</i>	Sweet	<i>Kapha</i>	<i>Pitta</i>	Purifies blood, improves vision, reduces fever	
<i>Munda Sali</i>	Sweet, sour	–	Reduces all three <i>doshas</i>	Pacifies poison and respiratory disorders	Helps in conditions such as boils and burning sensation
<i>Mahasali</i>	Sweet	–	<i>Pitta</i>	Enhances digestive fire, reduces fever and intestinal disorders	Reduces burning sensation and thirst
<i>Sugandha Sali</i>	Sweet	<i>Vata/kapha</i>	<i>Pitta</i>	Galactagogue, agent that promotes the flow of milk	Reduces thirst, tiredness, strengthens the body and developing fetus
<i>Thriya Sali</i>	Sweet	–	<i>Pitta</i>	Reduces fever	Prevents excessive heat, used for all disorders
<i>Sashtika</i>	Sweet	–	<i>Vata</i>	Carminative	Increases vitality and vigor
<i>White Samba</i>	Sweet	<i>Vata/kapha</i>	<i>Pitta</i>	Anthelmintic	Decreases tiredness, increases body strength

1. The *Bhojana-kuthuhala* (the 'joy of food') is a well-known 17th century work on dietetics by Sri Raghunatha Suri.

Rice-water as *anupan* (associated drink for medicine)

Various items are used as *anupan* (a drink or solid taken with or after a medicine), the most common ones being honey, betel leaf, and rice-water. Rice-water is used as *anupan* for many medicines. It is either used by just soaking rice in water, or as *maand*, prepared by boiling rice in excess water. It is used with the following Ayurvedic preparations: *Kamdudha ras*, *Amritanav ras*, *Pradharipu ras*, *Mahagandhak ras*, *Swarnmalti ras*, *Sutsekharas*, *Dughdavati*, *Pradaknasak churna*, *Laghumai ras*, *Pushpagn churana*, *Mukta sukti*, and *Sangrahat bhasm* to control various ailments such as vaginal and seminal discharges (white or red), irregularity of bowels, diarrhea, constipation, and dysentery.

Skin diseases

Before the advent of modern creams and talcum powders, rice powder and poultice were used for external application in the case of smallpox, measles, prickly heat, and other inflammatory infections of the skin, including burns and scalds, as it had a cooling and soothing effect.

Young girls in Japan now use *bihada* (Japanese for ‘beautiful skin’), a special type of *sake* rice, to beautify the skin (Anonymous, 1994).

Varieties with medicinal value

At present, a number of varieties with medicinal properties are grown and used in various states of India (Table 5). Das and Oudhia (2001) recorded 50 medicinal rice varieties during a survey in Madhya Pradesh. The deep red colored and long-sized rices of Chhattisgarh and Jharkhand are reported to be more nutritious than the red, white, and coarse-grained rices. Red rice varieties such as *Bhama*, *Danigora*, *Karhani*, *Kalamdani*, *Ramdi*, *Muru*, *Hindmauri*, and *Punaigora* are reported to be more nutritious; after consuming these rices only once, a person can work in the field for a whole day without feeling hungry. The cooked rice starchy water (locally called *mar* or *maand*) of red rice varieties helps keep a person fresh and energetic. Even after long hours of hard physical work, a person does not feel thirsty.

Table 5. Medicinal uses of rice varieties in the various states of India.

State	Rice variety	Medicinal use
Madhya Pradesh	<i>Aalcha</i>	Pimples, small boils in infant
	<i>Baissor</i>	Chronic headache, epilepsy
	<i>Gathuwanor</i>	Rheumatism
	<i>Karhani</i>	Paralysis
	<i>Kalimoonch</i>	Skin diseases
	<i>Maharaji</i>	Post-natal tonic for women
	<i>Bhajari</i>	Renewal of placenta in cows
Orissa	<i>Dhanwar</i>	Renewal of placenta in cows
	<i>Mehar</i>	Post-natal tonic for women
	<i>Saraiphool</i>	Post-natal tonic for women
Karnataka	<i>Kari bhatta</i>	Skin infections, increases milk in women
	<i>Karikagga</i>	Cooling effect
	<i>Atikaya</i>	Health tonic
	<i>Mullarya</i>	Cooling effect
Kerala ¹	<i>Nivara</i>	Cure of <i>tridoshas</i>
	<i>Erumakkari</i>	Cough
Himachal Pradesh	<i>Katheri</i>	Post-delivery restoration of size of reproductive organs
and Uttar Pradesh	<i>Kaflaya</i>	Leucorrhea
	<i>Matali, Lal Dhan</i>	High blood pressure, fever

1. *Oryza granulata* is used as contraceptive.

As tonic

Pakheru, *Saraiphool*, *Karia Gora*, *Dani Gora*, and *Punai Gora* varieties of eastern India are traditionally used as tonic. Boiled rice along with its starchy water and a pinch of salt is given to weak persons

(Rahman *et al.*, 2006). In Karnataka, the rice varieties *Karikagga* and *Atikaya* help in cooling the body and act as a tonic.

Food/diet for lactating mothers

Rice varieties have been specially used in increasing milk secretion in lactating mothers. The *Maharaji* and *Bhejri* varieties from Chhattisgarh, *Jonga* in Bihar, *Neelam Samba* in Tamil Nadu, and *Henati* in Sri Lanka are used for this purpose (Das and Oudhia, 2000).

Rice is offered along with fenugreek (*Trigonella foenum-graecum*) and salt or sugar to promote lactation. Another preparation used for the same purpose includes rice and coconut milk (Nagnur *et al.*, 2006). It is believed that balls of roasted *Jonga* rice mixed with sugar are helpful in producing milk and provide greater nutrition to the breast-fed child (Rahman *et al.*, 2006). The usefulness of rice for lactating mothers is knowledge that has been handed down over generations.

Post-delivery care

Rice also plays a role in post-delivery diets. Rice is cooked in excess water, and the starch is collected separately. One glass of this with jaggery is taken for five days. Rice has strengthening, hemostatic, and expectorant properties. It can even help in stopping bleeding (Nagnur *et al.*, 2006). In the Bhojpuri areas of Bihar and Uttar Pradesh, new mothers are given a highly nourishing preparation called *sathaura*: rice flour is mixed with ginger, gum of *Acacia arabica*/*Butea frondosa* and Bengal kino (seed kernel of *Buchanania latifolia* is known as *chiraunji*), coconut, and raisin, and made into balls with jaggery (Upadhyaya, 1993).

Skin care

The *Layacha* variety is used to treat boils on the scalp of a new-born child. The mother eats cooked rice of this variety, and the cure acts through the mother's milk ingested by the infant. Moreover, pregnant women are given cooked grain to help build resistance in the developing fetus against a skin infection known as the *Laicha* disease.

Other diseases

Red colored *Matali* and *Lal Dhan* rices of Himachal Pradesh help in curing blood pressure and fever. *Kafalya* rice from the hilly regions of Himachal Pradesh and Uttar Pradesh cures leucorrhea and helps in treating abortion complications. The *Bora* rice of Assam is given to patients suffering from jaundice. In Bihar and Jharkhand, *Karanga* rice is given in all dysenteric complaints.

Rice beer and its medicinal uses

The Bodo tribals of Assam consider rice beer to possess medicinal value, and use it for stomach ailments (Ahuja *et al.*, 2001). The *Karhani* rice variety is medicinally famous in Chhattisgarh and Jharkhand. Tribals of Jharkhand traditionally use this variety for the preparation of a beer called *Handia*, which has medicinal properties. Beer prepared from the *Dani Gora* rice is effective against gastric problems. Filtered water of *Gudna* rice, soaked in water overnight is given to patients suffering from gastric ailments.

Ethnobotanical medicine

In the Orissa-West Bengal region, the Lodha tribe prescribes a paste of rice roots and long pepper (*Piper longum*) (3:2) for the treatment of measles. They give grain powder with palm sugar (3:2) as an antidote to the *kuchila* (*Strychnos nux-vomica*) seed poison.

The Santhals use a mixture of water obtained after washing rice and common salt (2:1) as a cure for dyspepsia. The Mundas give 3–5 grains of rice with stale water in the morning as a cure for gastric troubles. The Santhals and Oraons give a powder obtained by burning old straw with curd (2:1) to women to induce abortion up to 2–3 months of pregnancy (Pal and Jain, 1998).

Veterinary uses

Raw grain and green plants of the *Dhanwar* rice variety of Chhattisgarh are given to cows for a safe pregnancy, healthy calves, and for easy removal of the placenta (Rahman *et al.*, 2006). Tribals apply rice bran with molasses (2:1) as plaster on bone fractures of cattle (Pal and Jain, 1998).

Present research

At present, rice is being seen under a different light – beyond its stereotype of staple food and primary source of carbohydrate or starch. Its mineral content, starch quality, glycemic index, and antioxidant activity has made rice unique among cereals. It has been found that, in comparison with other sources (wheat, potato, and maize), rice starch is nearly completely absorbed by the human body (Strocchi and Levitt, 1991). Positive qualities of high digestibility of starch, high biological value of amino acids, high content of essential fatty acids and selenium, and anti-hypertension effect have been confirmed scientifically. Rice can therefore be described now as a functional food.

Rice-based oral rehydration solutions (ORS) have been proved effective in decreasing stool output and improving intestinal absorption in acute diarrhea. Rice extracts were found to decrease intestinal losses by actively inhibiting chloride channels (Goldberg and Saltzman, 1996). Rice-based ORS are now preferred over glucose-based ORS, and have been included in WHO (World Health Organization) programs (Gore *et al.*, 1992). Rice is the least allergic food and is recommended for people afflicted with the irritable bowel syndrome. Colored rices (red and black) have been extensively studied and their anthocyanins or colored pigments and flavonoids are associated with antioxidant properties (Zhang *et al.*, 2005).

Red and black rices are considered more nutritious, have been found to be rich in iron (Fe), zinc (Zn), and minerals, and possess antioxidant properties. These rices reduced atherosclerotic plaque by 50% more than white rice in rabbits (Ling *et al.*, 2001). The parboiled red rices of Sri Lanka have lower glycemic index than white rices, and have been recommended for diabetics (Hettiarachchi *et al.*, 2001). The antioxidant and scavenging activity of red rice is higher than that of black and white rices (Shen *et al.*, 1994; Oki *et al.*, 2005). Clinical trials conducted in USA have concluded that red rice yeast reduces cholesterol and total triglyceride, providing a novel food-based approach to lowering cholesterol (Herber *et al.*, 1999).

Though rice contains high levels of complex carbohydrates and is categorized as a high glycemic index food along with bread and potato, many traditional varieties have been reported to have a low glycemic index (Rhoades, 2003). Basmati rice is one of them. It is now known that phytate in cereals ties with dietary Fe and keeps the human body from absorbing it. Basmati rice makes a metallothionein-like protein that is rich in cystine, that aids in iron absorption; this gene is being used in the development of Fe-rich rice through biotechnology (Chaudhary and Tran, 2001).

During these studies, it was found that basmati has medicinal value too. It has a low glycemic index, is high in Fe and Zn, and helps in the bio-availability (adsorption) of Fe. In the race to increase production,

we have neglected so far the rich treasure and heritage of small- and medium-grain scented rices that may possess equally good qualities in terms of their cooking, nutrition, and mineral content.

Rice meets most of the requirements of a good and healthy food. Rice is the only cereal that is eaten as a whole grain, which according to Ayurvedic texts is more easily digestible than flour.

Conclusion

India is home to a number of rice varieties that have medicinal properties and that fit the description of a health food in terms of modern as well as olden concepts. There is an urgent need to conserve these varieties that are fast disappearing under the pressure of high-yielding varieties and other cash crops. The need of the day is to aggressively market these varieties and promote them through greater public awareness about their importance, especially among the younger generation. Clinical validation of their medicinal value is necessary in order to establish a niche in the global market (the way China sells red rice yeast the world over). The promotion and conservation of this national heritage as a health food is critical in order to stem the onslaught of lifestyle-related diseases.

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