

Scented Rices of India

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Abstract

Scented rices have been known in the Indian subcontinent since the times of Charaka [600 BC (c. 700 BC – eds.)] and Susruta [200 BC (c. 400 BC – eds.)]. These rices have played an important role in many regional economies, and have been the favorites of kings, religious heads, royalty, and the elite of society. Most of these rices are highly area specific; hence each Indian state has its own special scented rice(s). Scented rices of short and medium grain size are grown in most states, but the long-grained basmati rice of northwestern India has gained popularity all over the country. It is known that scent is present only in a handful of rice varieties, and that it is conspicuously absent in wild rices. Biotechnological studies have revealed that scent originated as a mutation in normal rice in the BAD_2 gene. Even in the ancient times, the existence of several groups of scented rices was known. Like other rices, these have shown a spread from one area to another, revealing important links with important people and events in history. This paper attempts to bring together information on the history, diversity, and spread of scented rices, and the patronage offered by the royalty. It traces basmati from the Vedic period and its association with mahasali, the well-known variety of ancient and medieval times.

Rices that possess a scent in their plant parts and grains are known as scented rices. These rices emit the scent in the fields and during milling, and retain the scent in storage, and cooking (Gibson, 1976; Jefferson, 1985). Scent is not restricted to any specific type, and occurs in *indica* and *japonica*, glutinous and non-glutinous rices, long and short, coarse- and fine-grain types, and in black, red, and white rices. Scent is, however, conspicuously absent in all wild species. Scented rices were known since the ancient

times, and were considered the best among the specialty rices. Throughout the world, they have been the choicest food of kings, royalty, the elite of society, as well as the common man.

Scented rices have always had a special place in countries where rice is the staple. For example, in Japan, home-grown *Koshihikari* (scented rice) is considered worth its weight in gold. Black scented rices were a favorite of the royalty in China.

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Before the era of high-yielding varieties, about 30,000 traditional varieties were grown in India. Each state had its own distinct varieties evolved over centuries and well fitted into specific ecological niches. Traditional varieties included coarse, fine, scented, and non-scented types. About 300 scented varieties, exclusive to their respective states, were grown on a significant scale. Traditional scented varieties were low yielders, in comparison with the coarse types, and were usually grown for the rich and the noble classes. The common people could use such rices only on special occasions because of their high cost. Apart from being scented, these rices possess other desired traits characteristic of a good rice, such as sweet taste, high elongation ratio, and good cooked texture. Some important scented varieties of India include the basmati of northwestern India, *Kalanamak* of Uttar Pradesh, *Dubraj* and *Chinoor* of Madhya Pradesh, *Ambemohor* of Maharashtra, *Radhunipagla* of West Bengal, *Jeerakasambha* of Tamil Nadu, *Gandhakasala* of Kerala, and *Kalajira* and *Badshahbhog* of Orissa.

Some specific suffixes denote the scented nature, such as *joha* in Assam, and *bhog* in Orissa (Gangadharan, 1985). The word for scented rice in Manipuri is *chakao*, which

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means 'delicious rice'; *Chakao amubi* and *Chakao angouba* stand for black and white aromatic rices.

Historical perspective

The origin of such popular and sought-after scented rices is lost in antiquity. The earliest record is found in the Charaka Samhita [600 BC (c. 700 BC – eds.)]. Though the use of rice as an offering to God and various deities is mentioned in the Vedas, no particular reference is found on rice cultivation (Kumar, 1988).

The Rigveda [1000 BC (c. 8000 BC – eds.)], the oldest of the Vedas, mentions *dhan*, *dhana*, and *dhanya*. It is widely believed that these terms refer to rice, as the remains of both wild and cultivated rices have been found in sites dating back to the Neolithic period. By the time of the Yajurveda [1000 BC (c. 7000 BC – eds.)], rice attained the status of a holy grain and formed an integral part of offerings to God, in addition to its basic role in food (Kamal, 1988; Kansara, 1995). During this period, the term *vrihi* was used for rice. The different types of rices recognized included black (*krishnavrihi*), white (*shukla vrihi*),

large (*mahavrihi*), swift-growing (*asunamvrihi*), and wild (*nivara*) rice.

The *Taittiriya Brahmana* of the Yajurveda [1200 BC (c. 7000 BC – eds.)] mentions the use of specific rices as offerings to specific divinities. *Mahavrihi* rice was offered to *Indra*, the God of Rain and the noblest of Gods; black *krishnavrihi* to *Agni*, the God of Fire, white *shukla vrihi* to *Aditya*, the Sun God, and wild *nivara* rice to *Brihaspati*, the God of Speech (Kumar, 1988). Though religious scriptures refer to the specific and ritualistic uses of rice, there is no mention about places and methods of cultivation.

By that time of the Atharvaveda (c. 1000 BC), the terms *tandula* and *odana* were used respectively for rice and boiled rice. *Hayana*, the red rice mentioned in the *Satapatha Brahmana* of the Atharvaveda,

was also offered to *Indra*. No mention of scented rices is found in these treatises.

In the Buddhist period, the terms *sali* and *sugandha* for rice first appeared in the scripture *Vinaya Pitaka* and the Charaka Samhita [600 BC (c. 700 BC – eds.)] respectively. In his classical Ayurvedic treatise, Charaka classified rices into three types (*sali*, *vrihi*, and *shastika*); he listed 20 subgroups of *sali* (Table 1), one subgroup of wild types, and two subgroups of *shastika* (Kumar, 1988). Later, Susruta [200 BC (c. 400 BC – eds.)] identified 43 groups. Groups were differentiated on the basis of morphological characters such as husk, grain, and awn color, grain shape and grain and awn size, time of ripening and planting, growth duration, and presence of scent. This is evident from the varietal names such as *raktasali* (red *sali*), *mahasali* (large

Table 1. Various types of rices in Ayurvedic treatises.

Type	Charaka ¹	Susruta ²	Ashtanga ³	Madanpal ⁴	Bhavaprakasha ⁵	Kashyapa ⁶
<i>Sali</i>	20	17	25	22	15	4 <i>sali</i> + 3 <i>sambhaka</i> + 4 <i>kalama</i>
<i>Vrihi</i>		12	15	8	5	14 (including 3 <i>yava</i>)
<i>Shastika</i>	2	14	5	8	5	
Total	22 + 1 <i>nivara</i>	43	44	38	25	25 + 1 <i>nivara</i> + <i>suka</i> (unclassified)
Scented	3	4	4	4		4 (<i>deergasali</i> , <i>palasa vrihi</i> , <i>kala vrihi</i> , <i>kalama</i>)

1. *Carak Samhita*. Rajeshwar Dutt Shastri. Chaukhamba Bharati Academy, Varanasi, India.

2. *Susruta Samhita* (Agnidev, 1975; Sharma, 1999; Dalhan, 2003).

3. *Ashtang Hrdaya* (Paradkar, 1939, 1985); *Ashtang Sangrah* (Ravi Dutt Tripathi, 2001).

4. *Madanpal Nighantu* (Ravi Dutt, 1951).

5. *Bhavaprakash Nighantu* (Chunekar and Pandey, 1998).

6. *Kashyapiyakrahisukti* (Ayachit, 2002).

grained), *kalama* (strong pen-like stem), *pandu* (pale awns), *mahish* (black husked), *rodhrapusaka* (red like the *rodhra* flower), and *dirghashuka* (large awned). Scholars such as Charaka and Susruta studied plants and rice varieties in the context of their medicinal value. *Mahasali* and *sugandhika*, *promodaka*, *pundrika*, and *pushpandaka* groups were identified as scented (Vidyalankar, 1994).

In the 9th century Kashyapiyakrishisukti, one of the earliest treatises fully devoted to agriculture, the philosopher Kashyapa gives an elaborate account of the cultivation method, seed collection, and classification of rice varieties (Ayachit, 2002). Kashyapa classified rice into 26 groups on the basis of the cropping season, time of cultivation, and morphology of grain, with the following distinct types: *sali*, *kalama*, *vrihi*, *yava*, *sambhaka*, and *nivara*. Among these, the *sali*, *kalama*, *sambhaka*, and *vrihi* types had a scented subgroup – long *sali* (*deergasali*) having a sweet flavor, black *sambhaka*, *palasa vrihi* (full of flavor), and *kalama* (possessing great flavor). Kashyapa writes that *shastika* was created by God as a tasteless grain, while the *kalama* is sweet and flavory (Raychaudhuri, 1964). It is interesting that the number of varieties in the *vrihi* and *shastika* groups has gone down with time. This may be due to the preference for *sali* rices, which were considered among the best in most parts of India.

Charaka included three groups in scented rices – *mahasali*, large-grained; *sugandhaka*, flavored; and *pramodaka*, fragrant. Later, Susruta listed five groups – three of Charaka's time, and, in addition,

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pundrika, fragrant like a white lotus; and *pushpandaka*, grains with the fragrance of flowers (Table 2). Charaka and Susruta listed the *kalama* group, but did not mention it to be scented, while Kashyapa identified the scented *kalama*. Four scented types were identified: *deergasali* (long with sweet flavor), black *sambhaka*, *palasa vrihi* (red like the flowers of *palasa*), and *kalama*. Charaka and Susruta listed scented varieties in the *sali* and *shastika* types, while Kashyapa included additional groups in the *vrihi* and *sambhaka* types. Charaka included *promodaka* in *sali*, while Susruta and later Madanpal classified it in the *shastika* type. Kashyapa lived in South India, therefore, no common variety from Charaka and Susruta's list is found in Kashyapiyakrishisukti. *Deergasali*, the long-grained scented variety, may be the same as *mahasali*, but no details are available.

Diversity of scented rices

Indian scented rices constitute a diverse group; they differ in the type of aroma, morphological characters, and iso-enzymatic classification. The majority of scented rices are short-grained; some are medium-grained, and only a very few are long-grained. These varieties are highly thermo-photosensitive; they are mostly tall, long-duration types, low

Table 2. Scented rices identified at various times during the course of history.

Group of rice variety	Literal meaning	First referred by	Referred as scented by	Notes
<i>Mahasali</i>	Large	Charaka	Charaka [600 BC (c. 700 BC – eds.) Hiuen-Tsang (640 AD)]	
<i>Kalama</i>	Stiff stem	Charaka	Kashyapa (800 AD)	
<i>Sugandhika</i>	Fragrant	Charaka	Charaka [600 BC (c. 700 BC – eds.)]	
<i>Promodaka</i>	Fragrant	Susruta	Susruta [200 BC (c. 400 BC – eds.)]	
<i>Pundrika</i>	Softness, color, and the fragrance of a white lotus	Susruta	Susruta [200 BC (c. 400 BC – eds.)]	
<i>Pushpandaka</i>	Grains with the fragrance of flowers	Susruta	Susruta [200 BC (c. 400 BC – eds.)]	
<i>Black sambhaka</i>	Black	Kashyapa	Kashyapa (800 AD)	
<i>Palasa vrihi</i>	Red, full of flavor	Kashyapa	Kashyapa (800 AD)	
<i>Sukhdas</i>		Ain-i-Akbari	Ain-i-Akbari (1590 AD)	Deep water rice
<i>Madhkar</i>		Ain-i-Akbari	Ain-i-Akbari (1590 AD)	Deep water rice
<i>Jhanwar</i>		Ain-i-Akbari	Ain-i-Akbari (1590 AD)	Deep water rice
<i>Mushkin</i>	<i>Musk</i> means scent	Ain-i-Akbari	Ain-i-Akbari (1590 AD)	
<i>Deergasali</i>	Long with sweet flavor	Kashyapa	Kashyapa (800 AD)	
<i>Gandhsali</i>	Scented	Someshvardeva	Someshvardeva (1126–1138 AD)	Possibly, <i>sugandhika</i> of Charaka

yielding, and prone to lodging. One of the most sought after long-grained varieties, basmati, grows only in northwestern India, whereas other regions grow short- to medium-grained scented rices (Rani and Krishnaiah, 2001).

In addition to grain size, scented rices differ in other morphological characters such as plant height, duration, panicle length and type, husk and kernel color, awning, apiculus, etc. Scented cultivars also differ in such

physiochemical traits as grain elongation, cooked grain texture, gel consistency, and degree of aroma. An analysis of a representative set of 316 Indian scented cultivars revealed a large variation for all traits, except for AC and GT (Singh, 2000).

Though scented rices occur in almost all Indian states, only Assam, Bihar, Chhattisgarh, Uttar Pradesh, Uttaranchal, West Bengal, and Orissa have a large number of such varieties (Table 3). The

Table 3. Scented rice varieties in India and their distribution.

State	Varieties (district)
Assam (65)	Ranga joha I, Joha (47 types), Bongali, Bor, Bhabeli, Kanjoha, Kanku, Khorika kala, Kopausali, Manki, Ranga, Rampal, Bagri bhog, Tulsi bhog, Govind bhog, Badshahbhog, Prasad bhog, Malbhog, Kalajira
Bihar (42)	Basmati 3 (Patna); Katarani (Bhagalpur, Champaran); Kari bank (Patna, Bhojpur, Munger, northern Bihar); Mohin dhan, Sagarbhog, Hansraj (Patna, northern Bihar); Sonachur (Bhojpur, Rohtas, northern Bihar); Badshahbhog (Bhojpur, Bhagalpur); Kanakjira (Bhojpur, northern Bihar); Shamjira (Rohtas, Aurangabad, northern Bihar); Shapasand (Rohtas, northern Bihar); Tulsi phul (Rohtas, northern Bihar); Kanehonehur (Gaya); Mehijawain (Aurangabad, northern Bihar); Tulsimanjri (Bhagalpur, Munger, northern Bihar); BR 9, BR 10 (Bhagalpur, northern Bihar); Marueya, Lakhisar (Munger, northern Bihar); Badshahpasand, Bahraini, Bhuri C. basmati, Chenaur, Devtabhog, Kamod, Kali Champaran basmati, Kesarbani, Lal C. basmati, Marcha, Malbhog, Ramjawain, Sonalari, Tulsipasand (northern Bihar); Mircha, Malida, Satari (Muzzafarnagar); Amad, Abdul, Ramjain (western Champaran); Brama bhusi (Semra, Ramgarh, western Champaran); Deobhog (Darbhanga); Kamini (Bhagalpur)
Gujarat (5)	Pankhali, Kamod (Kheda); Krishnakamod (Ahmedabad); Kolhapur scented (Saurashtra); Zeersal
Haryana (2)	Basmati 370 (Rohtak, Kaithal); Karnal local (Karnal, Kurukshetra, Panipat)
Himachal Pradesh (9)	Mushkan, Ramjawain, Achhoo, Seond basmati, Baldhar basmati, Madhumalati, Chetru basmati (Kangra valley); Pansara local (Kullu); Hathkoti basmati (Shimla)
Jammu and Kashmir (7)	High hills: Gul zag, Zagir, Muskkanti, Tumlazag ; Mid-hills: Musk budji, Qadir baig, Ranbir basmati (R.S. Pura, Katua, Jammu)
Karnataka (19)	Ambemohor (Belagoan, Dharwar); Devamallig (north Kanara), Gumsali (Haveri); Gandhsali, Gulvadi, Gamanasanna (south Kanara); Huggibatta (Belagoan, Dharwar); Jeerigesanna (Mysore, Bangalore, Kodagu, Chikmanglur); Kagisali (Belagoan, Dharwar, Haveri); Kumudh (Haveri); Karigajavile (Belagoan, Dharwar, Haveri); Krishnapasangi (Raichur, Gulbarga, Bellary); Kunsum Kesari (north Kanara); Kalabatta (Tumkur, Bangalore); Kavali (Bidar); Rattansagar (Bidar); Sindhagi local (Bijapur); Vasane Sanna Batta (north Kanara); Yalakkisali (Haveri)
Kerala (7)	Gandhakasala, Jeerakasala, Velumbala, Chomala, Kayama (Wyanad); Kothampalari (Kannur); Pookkilathari (Palakkad)
Madhya Pradesh (33)	Amarjyoti (Mandalla); Adamchini, Antraved (Damoh, Panna); Badshahbhog (Bastar); Batanphul (Sidhi); Chakarbhata (Chattarpur); Chhatri (Jabalpur); Chindi kapur (Raigarh); Chinoor (Balaghat); Chirna khai (Bastar); Dilbaxa (Tikamgarh, Satna, Reva); Dubraj (Raipur, Durg, Rajnandgaon, Bilaspur, Mahasamund, Dhamtari, Janjgir, Korba, Kanker); Gangaprasad (Rajnandgaon);

continued

Table 3. *continued*

State	Varieties (district)
	Kapursar (Raipur, Durg, Rajnandgaon); Kubrimohr (Raipur, Durg); Loktimanchi (Bastar); Mekhra bhundha (Durg); Samodchini (Bilaspur, Surguja); Kalimoonch , Ganju (Gwalior); Shakarchini (Surguja, Shahdol); Sri kamal (Shahdol); Tulsiamrit (Raigarh, Seoni); Laloo (east Madhya Pradesh); Vishnuparag , Tedai , Chini gauri , Chiranki , Kali kamod , Kakti manchi , Mekrabidu , Vishnubhog , Banaspatri (pockets)
Maharashtra (6)	Ambemohor , Krishna sal (Pune, Satara, Ahmednagar); Banaspatri , Chinoor (Vidharbha); Gham (Raigad); Ghansal (Kolhapur)
Manipur (5)	Chakao angouba , Chakao amubi , Phoren mubi , Langgphou anganba , Chakao poireiton
Mizoram (6)	Tai , Pharate , Bawang buh , Mawang buh , Zongam , Phanrai
Orissa (33)	Thakurbhog , Ratnasidol , Prabhatjeera , Nalidhan , Manasi , Jhinghasali , Sitakesari , Barangamali , Basnaphali , Jala , Jhilipanjiri , Lekhtimahi (Orissa); Kalajira (Cuttack, Puri, Ganjam, Koraput); Dubraj (Keonjhar, Deogarh, Sambalpur, Bolangir, Jharsuguda); Badshahbhog (Bolangir, Balasore, Koraput, Bhadrak); Durgabhog (Keonghar, Mayurbhanj, Phulbani); Pimpdibsa (Keonjhar); Mugajai (Phulbani, Koraput); Krishnbhog (Puri); Govindbhog (Cuttack); Chinikamini , Saragdhuli , Padamkesri (Konark, Puri); Karpurakali , Pusimakenda (Neyagarh); Kalikati (Kalahandi); Thakurbhog (Puri); Karpurakanti , Suragaja , Laxmibilas (Bolangir, Sambalpur, Deogarh); Tulsiphulla (Puri); Gangabali (Ganjam); Kanikakala
Punjab (2)	Basmati 370 (Amritsar, Gurdaspur, Jullundur); Quadian basmati (Amritsar, Gurdaspur)
Rajasthan (6)	Basmati , Danger , Sutar , Pathania , Ratipanne , Zed zeera
Tamil Nadu (1)	Jeerakasambha
Tripura (5)	Govindbhog (white); Govindbhog (black); Sada khaja , Kalakhau , Kalijira
Uttar Pradesh (20)	Kalanamak (Basti, Sidharthnagar, Maharajganj, Gonda, Goroli); Adamchini (Balua); Bindli (Pauri); Badshahbhog (Bareilly, Rae Bareilly, Allahabad, Partapgarh); Batanphul (Basti, Sidharthnagar, Ajana, Mau, Sultanpur); Benibhog (Barabanki); Dhania (Basti, Gonda); Dulhanian (Baraich); Hansraj (Dehradun, Rampur, Pilibhit); Jeerabati (Basti, Varanasi); Kamalijira (Basti, Sidharthnagar, Baraich); Lalmati (Baraich, Barabanki); Laungchoor (Mirzapur, Varanasi); Phool chameli (Varanasi, Mirzapur, Son Bhadra); Ramjawain (Basti, Sidharthnagar); Shakarchini (Varanasi, Mirzapur, Son Bhadra); Sonachur (Mirzapur, Varanasi); Tilakchandani (Rampur, Pilibhit, Nainital); Tulsimanjri (Balua); Vishnuparag (Barabanki)
West Bengal (15)	Radhunipagla (Birbhumi, Bankura, Burdwan); Badshahbhog (Burdwan, Hooghly, Bankura); Kalonunia (Duaras, Jalpaiguri); Kataribhog , Seetabhog (Dinajpur); Gandheswari (pocket); Chinisakar (Raiganj); Ramtulsi (Darjeeling); Tulsibhog (north Bengal); Tulaipanji (Dinajpur); Mahishadan (Bankura); Govindbhog (Hooghly, Howrah, Nadia); Patina , Basmati , Kalijira

center of diversity of scented rices of the Group V gene pool is considered to be the foothills of the Himalayas in Uttar Pradesh, Bihar, and Nepal, from where they spread to West Bengal, Assam, and other states downwards (Khush and Cruz, 2001).

A study on the world stock of scented rices revealed that about 4% of the world stock possesses scent (Richharia *et al.*, 1965). Scent occurs in the cultivated species, and no wild rice possesses scent. Temperate region varieties (2.2%) were found to be more scented than tropical region varieties (1.74%). The low percentage of scented rices in the world stock was considered indicative of their recent origin in comparison to normal rices. Recent studies on molecular markers have revealed that aroma arose as a mutation on the 8th chromosome as a deletion (8bp) on exon 7 of BAD₂ genes (Sakthivel *et al.*, 2006). The inclusion of scented types in a period later than the Vedas also gets support and is corroborated by biotechnological studies and observations (Richharia *et al.*, 1965). Future biotechnological studies may shed more light on their origin. Until recently, varieties were classified as scented or non-scented based on the amount of 2-acetyl-1-pyrroline (2-AP), but recent studies at the Directorate of Rice Research, Rajendranagar, Hyderabad, show that many Indian scented varieties (*Tarunbhog*, *Ganjeikalli*, *Bansphool*, and *Adamchini*) possess an insufficient amount of 2-AP and are without the deletion of the BAD₂ gene (Sakthivel *et al.*, 2006). In ancient Ayurvedic treatises too, five distinct types of scented groups were listed on the basis of distinct aroma.

They classified and named these groups on the type of aroma as *mahasali*, *sugandhika*, *promodaka*, and *pundrika*. Various types of gene control in aromatic rices have been reported as monogenic, digenic, or trigenic. According to isoenzyme classification, the scented rices of India belong to all the six groups, though most of them fall into Group V (Glaszmann, 1987). This indicates the possibility of allelic and genic diversity for scent.

What is scent?

The compound that imparts a particular aroma to an individual scented variety has not been fully investigated (Weber *et al.*, 2000). Buttery *et al.* (1983), who were the first to analyze the volatiles of cooked scented rices, recorded 114 compounds and established that the major contributor to aroma was 2-acetyl-1-pyrroline (2-AP). These volatile compounds were grouped under 13 hydrocarbons, 14 acids, 13 alcohols, 16 aldehydes, 14 ketones, 8 esters, and 5 phenols. A study conducted by Widjaja *et al.* (1996) assigned odor descriptions to 70 compounds as grassy, woody, mushroom, fruity, and floral. The major volatile components of various scented rices of the world were compared. They recorded the aromatic component of different varieties as given in the parentheses following the varietal name: Goolarah (Indole, 2-AP), YRF 9 (2-AP), Jasmine (Floral indole, 2-AP), and Basmati (2 phenyl ethanol, 2-AP, sweet floral). Future studies at the molecular and biochemical level may shed more light on the diversity for scent as envisaged/indicated in ancient Indian Ayurvedic treatises.

Spread of rice and scented rice

It is human nature to carry one's favorite things or eatables to distant places wherever one goes. This habit has helped the movement and spread of a number of plant and animal species to distant lands. Alexander is known to have carried rice from India to Greece, from where it spread to the whole of Europe and the Americas (Raju, 2000). The earliest Indian record of the spread of rice varieties seems to be that of *Shakunhrita*. The literal meaning of the word *shakunhrita* is 'brought by birds'. Dalhana, the most authoritative commentator of the *Susruta Samhita*, mentions that *Shakunhrita* was brought to Magadha from *Uttarkaru* (near Delhi). It is said about this rice, *Dviuprant samanito garukena mahatamna, Shakunhrita sa salih syad gerudaparanamkah* ("that which is brought from another country by *Garuda* is known as *Shakunhrita* or *Garuda*").

The majority of scented varieties are area specific, and their best quality is obtained only in their native areas. The good cooking quality of scented rices tempted people to introduce these into other states. *Badshahbhog*, a variety native to Orissa is grown in Assam, Bihar, West Bengal, and Madhya Pradesh. Similarly, *Kamod* is grown in Uttar Pradesh, Rajasthan, Gujarat, and Maharashtra, and *Ambemohor* is cultivated in Maharashtra and Karnataka.

The *Pankhali* and *Kamod* scented varieties of Gujarat offer another example of such movement and spread. These were brought

from Varanasi to Gujarat some 200 years ago by farmers returning from pilgrimage. Before the introduction of these scented varieties, only coarse varieties were grown in Gujarat (Pathak and Mehta, 2003). The people of Manipur believe that rice came to Manipur with the largest of its tribes, the *Meiteis* (Singh and Baghel, 2003).

The most exciting example of scented rices in India is that of basmati. This highly prized scented rice has been introduced to almost all the states of India. It has traveled from the northwestern part of the Indian subcontinent to Iran in the west, to West Bengal in the east, and down to South India.

Basmati, like many other types of rice, has red-brown, black, and golden husk variants. The red-brown-husked paddy known as *Mushkin* or *Lal basmati* was grown on vast areas (Roberts and Singh, 1951). It was comparatively more resistant to storage insects and pests than light-colored basmati. *Mushkin* was used in the royal kitchen of Akbar. It was described as a dark-husked rice that ripened quickly, and had small and white grains, was fragrant and pleasant to taste. Similarly the famous *Champaran basmati* of Bihar occurs in three husk colors.

Many landraces of basmati have been grown in the northwestern parts of India since long. *Mushkin* dominated the West

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The Prime Minister of Iran, Mirza Agha Khan, took *Sadri*, the equivalent of basmati, to Iran from India (Shaïda, 1992). Similarly, under the requirement and desire of the Nawab of Hyderabad, a selection of the *Amritsari* variety (basmati), HR 12, was developed in the erstwhile State of Hyderabad.

Royal patronage

In the Indian subcontinent, the royals were possessive of the scented rices. *Bara* (*Peshawari Basmati*) could only be grown under the king's supervision near the fortress of Bara in Peshawar. Ordinary people were not allowed in the proximity of the fields, and taking the grain was a punishable offence. This rice formed part of the gifts sent to Maharaja Ranjit Singh in 1822 by Yar Mohammed Khan in the hope of propitiating him (Ahuja *et al.*, 1995). Similarly, *Tapovan basmati* was grown under the decree of the King of Tehri, Uttaranchal. The entire Tapovan village of Tehri used to grow basmati for the consumption of the royal family. Later, the *Mahant* (Head Priest) of the local temple acquired this right. In central India, the Nawab of Hyderabad was also fond of basmati rice, and ordered it to be grown in his kingdom. The *Kalanamak* scented rice of Siddharthanagar area (near Pantnagar) is associated with Lord Buddha, who is said to have given the seeds of this rice to the people (Singh *et al.*, 2003b). Likewise, *Ambemohor* rice was popular among the Maratha rulers and the rich of society. The scented rices used in the royal kitchen of Emperor Akbar included *Mushkin*, *Sukhdas*, *Madhkar*, and *Jhanwar*. Among

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all the cultivated varieties in Akbar's time, *Mushkin* fetched the highest price. Out of all the varieties grown in Awadh, Bengal, and Bihar, *Sukhdas* rice was the best. The author of *Mukuhtasiru-i Twarikh* states that "Its quality and flavor are beyond all praise. It is equally palatable to kings and the common people. It is incomparable in tenderness and sweetness, and has a very agreeable smell and taste. The rich and the great, and those who are fond of good living, think that no other food is so excellent." *Sukhdas* rices were scarcely to be matched for whiteness, delicacy, fragrance, and wholesomeness. Abul Fazal remarked about the unmatched quality and quantity of Bihar rice (Blochmann, 1989). In Kerala, scented *Gandhakasala* is grown by rich farmers, and the *kanji* made from it is known as *Thambaikanja*, meaning the 'food of the Gods' (Leena *et al.*, 2003; Nerkar *et al.*, 2003; Singh *et al.*, 2003a). In Orissa, *Krishnbhog*, *Govindbhog*, *Tulsibhog*, and *Prasadbhog* indicate their association with God and were used in temples, while *Badshahbhog*, *Rajbhog*, and *Kamini bhog* signify their association with kings and emperors. Some of these are grown under the control of temples (Das *et al.*, 2003). The scented variety of Manipur owes its name *Chakao poireiton* to the legendary hero Chingkhong Poireiton (34–18 BC).

Tracing basmati

Various commentaries on Ayurvedic treatises and *nighantu* written during different periods provide us information on rice varieties grown in the specific areas to which the various commentators belonged. In addition to the Charaka Samhita and the Susruta Samhita, the works of Vagbhata – *Ashtangasangraha* and *Ashtangahridaya* – are especially popular with South Indian *vaidya* or traditional doctors. The three great Ayurvedic philosophers, Charaka, Susruta, and Vagbhata referred to as the *vridha trayi* or the Trio of Elders, provide information on food and its relation to human health. Their treatises refer to a number of groups in three types of rices (Tables 1 and 2). There was much variation in the names of varieties in different areas, as can be gathered from the English rendering of a *sloka* by Dalhan, one of the earliest commentators of the Susruta Samhita: "*Raktasali* is popularly known by different names in different regions, as the same substance is called by different names in different regions, such as cooked rice is called *bhakta* (*bhata*) in the North while *kura* in the South. Hence awned, leguminous and inferior cereals should be known from farmers of different areas. Likewise, animals should be known from hunters in different regions, birds from fowlers, tubers and roots from mendicants in forests living on these diets, vegetables from the inhabitants of villages and forests, food properties from cooks, market drugs from shopkeepers and drugs (roots, etc.) to be collected from hermits and tribal people."

In keeping with the age-old practice, an attempt is made here to trace the names of present-day rice varieties through a number of works published at different times and in different regions (see list given under Table 1).

Like other rices, scented rices too were named on the basis of their morphological characters and scent. Charaka, Susruta, and later Kashyapa identified six different types of scented rices based on the variation in scent. Various commentators of Charaka and Susruta identified some varieties that are still under cultivation. Dalhan's commentary on Susruta is highly regarded in Ayurvedic circles. *Raktasali* has been identified with *Lalmati* grown in Uttar Pradesh and *Daudkhani* grown in *Anthradesh* (the area between the rivers Ganga and Yamuna). *Daudkhani* finds mention in the "Races of Rice in India", and at present stands in the list of recommended varieties for cultivation in Bangladesh and Orissa (Watt, 1891; Alim, 1959). A variety called *Raktasali* is cultivated in Kerala even today. *Pandu* (yellow awned) is identified with *Ramjawain* grown in Uttar Pradesh, and was also grown in Haryana and Himachal Pradesh. *Hayana* has been traced back to *Sankvak*, *Sanguvak*, or *Gotakpuccha* (like a horse's tail) as referred by Jeijatt (in Dalhan's *Tikka* on *Susruta*). *Sukhdas* has been traced to *sugandhika* (Nene, 2005).

There is some disagreement regarding the identity of basmati in the context of Ayurvedic literature. Some annotators of Ayurvedic treatises have considered present-day basmati to be *sugandhika*,

while others consider it to be *mahasali*. However, *mahasali* seems to be more convincing. Identifying *sugandhika* (*devsali*) mentioned in the Charaka Samhita and Susruta Samhita as basmati does not seem convincing as varieties/groups in olden times were named on the basis of their morphological characters such as husk, grain and awn color, grain size, and awn length. The group name *sugandhika* signifies 'aroma', but does not convey any grain size. Moreover, basmati possesses grains that are longer than those of any known scented varieties. Had the grain size of *sugandhika* been large, it would have carried the prefix *maha*, on the lines of *mahadushika*, *mahatandul*, *mahakalama*, *mahasali*, *maharaja*, etc. Moreover, scented *mahasali* has been included along with *sugandhika* in the Charaka Samhita, Susruta Samhita, and *Ashtangasangraha* and *Ashtangahridaya* (Vidyalankar, 1994). *Sugandhika* referred by Charaka and Susruta was known as *Takkidhan* in Ujjain, as *Devsali* in Deoghar, Bihar, Gond, and Malwa, and as *Gandhsali* in Jullundur and Magadha. Someshvardeva, a Chalukya king (1126–1138 AD) has mentioned *Gandhsali* in his encyclopedic work, *Manasollasa*. It

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is referred as *sugandha sali* in the 17th century *Bhojana-kuthuhala* of Sri Raghunatha Suri. Varieties with similar names such as *Gandhsali* and *Gandhakasala* are grown nowadays in Karnataka and Kerala respectively.

Is *mahasali* today's basmati?

Mahasali may be identified with basmati as no other variety since the Vedic times (*Taittiriya Samhita*) is known to be fragrant and possessing large grains. References to *mahasali* and its use in offerings are common, but Vedic sources do not mention its areas of cultivation. Recorded accounts of foreign travelers in India reveal that during the post-Vedic times *mahasali* was produced mainly in Magadha (Gode, 1944; Puri, 1957; Beal, 1973). Hiuen-Tsang (also known as Yuan Chuang and Hsuan Tsang, 640 AD) visited India in the reign of Harshavardhana and mentioned the scented *sali* rice called *mahasali*, grown in Magadha and nowhere else. This rice was described as having large grains and fragrance and was reserved for people of eminence (Sharma, 1970; Beal, 1973). Later, Hiuen-Tsang's disciple, Shaman Hwui Li, referred to *mahasali* as "rice that is as large as the black bean and when cooked is aromatic and shining, like no other rice at all. It grows only in Magadha, and nowhere else. It is offered only to the king or to religious persons of great distinction, and hence the Chinese name *kung-ja-tin-mai* ("rice offered to the great householder"). Kamal (1988) writes: "It was termed *mahasali* because it was a prized food item, and used specially by the rich

peasants and the nobles whose household establishments were comparatively larger, proving their superior material prosperity." This variety was restricted to the Magadha kingdom in the 6th century, but later spread to South India by the 13th century (Swami, 1973). Epigraphical evidence reveals that the same variety was being cultivated in 1200 AD at Managoli and Abbator.

Basmati is grown in pockets of Bihar along with many other types of scented rices. It is interesting to record that Kautilya did not mention the word basmati or *mahasali*, though he has mentioned *sali* rices in his *Arthashastra*. In northwestern Punjab, only long-grained, scented varieties such as basmati, Hansraj, and Begumi are grown, whereas in Bihar, except for basmati, all are short-grain types. The introduction of this much sought-after variety to Bihar is possibly linked to the highway (now the Grand Trunk Road) that was built by the Mauryan kings between Taxila, the great seat of learning of that period, and Pataliputra, the seat of power (http://www.en.wikipedia.org/wiki/Grand_Trunk_Road).

Confusion about the identity of scented varieties *mahasali* and *kalama* crept into Ayurvedic literature. To straighten the record, Gode (1944) tabulated information on the two varieties from various sources such as Charaka, Susruta, Kharnadi (650 AD), *Ashtangasangraha* (625 AD), Hiuen-Tsang (640 AD), *Ashtangahridaya* [8 to 9th century (c. 700 AD – eds.)], Chakrapanidatta (1100 AD), Arunadutta (1220 AD), and Hemadari (1250 AD). Among these authorities, Charaka, Susruta,

Kharnadi, Chakrapanidatta, and Hemadari have distinguished *mahasali* and *kalama*. The distinction between *mahasali* and *kalama* was maintained in the medical tradition from Charaka and Susruta up to 1300 AD or so (Gode, 1944). It is, however, certain that *mahasali*, in the 13th century, was a specialty of Magadha, as expressed by Hemadari (a minister of Yadava, King of Devagiri, Daulatabad). The fame of Magadha as the home of the *mahasali* variety remained intact from c. 630 AD to c. 1060 AD, a period of 430 years. Hemadari's view receives support from Gode, who has evidently distinguished *kalama* and *mahasali*, and regarded *kalama* as slightly inferior to *mahasali*.

Records also show a mention of the *mahasali* variety in 1126–1138 AD by the Chalukya king Someshvardeva (Misra, 1982). *Mahasali* also figures in the *Bhojana-kuthuhala*, a Sanskrit treatise on the art of cookery written by Sri Raghunatha Suri (17th century), a close associate of Swami Ramadas, the Guru of the famous Maratha ruler Chatrapati Shivaji (Vijayalakshmi and Sunder, 1994). The variety appears in a Gujarati work of 1520 AD called the *Varanaka samuchaya* (Achaya, 1998). It is not clear when and how these long-grain scented varieties came to be known later as basmati. The first written record of the word 'basmati' is found in the epic poem *Heer*, a composition of Varis Shah (Ahuja *et al.*, 1995; 1997; Ahuja and Ahuja, 2006).

The prehistoric Aharians (1800–1400 BC) certainly ate rice. Abundant impressions of rice husks on potsherds have been found

from Phase A, Period I (Randhawa, 1980). Interestingly, in the period of the *Taittiriya Samhita* (1000–600 BC), around 800 years later, the use of *mahavrihinam*, a large-grain fragrant variety, is reminiscent of the Aharian long-grained rice as it has been considered as the predecessor of Basmati (Randhawa, 1980; Ahuja *et al.*, 1995).

The *mahavrihinam* of the *Taittiriya Samhita* period and the *mahasali* of Magadha were the same as the present-day basmati. This view has been earlier expressed by Kamal (1988) on the basis of ancient texts accepted by Vedic scholars (Kansara, 1995). Therefore, in view of the evidences available in the archeological excavations, literature, epigraphical records, and Ayurvedic treatises, it is suggested that the variety *mahasali* of Charaka and Susruta, the *mahavrihinam* of the *Taittiriya Samhita*, and the present-day basmati should be considered as the one and the same variety.

Mahasali, as is clear from evidences, spread from northwestern India to Magadha, and later spread to South India, but it might have lost its fragrance away from its native land, and not been referred to as a scented variety in southern literature. It is well established that though basmati may be grown anywhere, its cooking quality and taste are not the same as when cultivated in its home area.

Among the scented rices, only basmati caught the attention of traders, exporters, and scientists the world over, due to its long, slender grains and excellent cooking qualities. Every country of the world wanted to introduce its qualities into their varieties,

and it became the most sought after research material. During these studies, it was found that basmati has medicinal value too. It has a low glycemic index, is high in iron and zinc, and helps in the bio-availability (adsorption) of iron. 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.

It is high time that we recognize our duty towards scented rices, and direct our energies to the preservation and promotion of this heritage, which our ancestors have religiously preserved for this generation. The Chinese have reported that the flavonoids of black scented rices possess antioxidant properties. Such studies are required to identify the unknown qualities (glycemic index, mineral content, antioxidant properties, etc.) of Indian scented rices too.

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