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Exploring the Bioactives and Therapeutic Properties of Traditional Rice Landraces for Human Health and Food Security: A Review

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ABSTRACT

Rice has been found to have anti-cancer, anti-diabetic, anti-inflammatory properties and it is believed to be due to its antioxidant properties. The research work on characterization of rice landraces for nutritional and medicinal properties is gaining importance due to increase in lifestyle related health issues such as diabetes, cancer, heart problems, obesity *etc* and increasing trend among consumers and profitable market is reversing and focusing towards traditional rice landraces. These rice land races exploited by the rural folks to treat to treat skin diseases, blood pressure, fever rheumatism, lactation and also uses as health tonic. Some of the rice landraces used in *sidda* and *ayurvedic* for exploiting curative value and is used in many medicinal preparations. Based on Vedic evidences, India was had more than 2,00,000 (2 lakh) rice varieties which is an huge biodiversity, genetically rich nation, no other nation in the world as that resources. The rice landraces cultivation are confined to certain pockets depending on the suitability of local climate and soil type, under varied quantity of water requirement, also having resistance to pest and diseases. Currently, a few hundreds of traditional landraces are in existenceand being cultivated in small pockets by farmers. Conserve the available landraces, the nutraceutical and nutritional properties in rice landraces, needs to be examined and validated with popularization. Indigenous cultivars will help for explore the scientific basis of therapeutic values by the scientist for sustaining food as well as the nutritional security and human health.

Key words: Anticancer properties, Black rice, Nutraceutical properties, Pigmented rice, Red rice, Rice landraces, Therapeutic properties.

As the world struggles to find a cure for COVID-19, health experts have indicated that boosting the immune system of the body can help to mitigate the effects and accelerate disease recovery. The food products of Ayurveda are potent aids to improve the immunity of the body against harmful viruses. Rice is one of the world's most important medicinal crops and is also a staple food for more than half of the world's population. Worldwide, rice is grown in 165.16 million hectares, with an annual production of 741 million tons and productivity of 4486 kg/ha. About 90% of the world's rice is grown and produced (146.94 million ha area with a production of 671 million tons and productivity of 4566 kg/ha of paddy) in Asia. Rice is grown in 43.94 million ha with a production of 159.2 million tonnes and productivity of 3623 kg/ha in India. Rice, as a staple food, has characteristics that go beyond its nutritional value, such as high digestion and low allergy potential when compared to other cereal grains. Due to the development of contemporary high yielding varieties (HYVs), hybrids and genetically modified rice traditional rice landraces in India and Asia are in grave danger of extinction (Mahendran *et al*., 2024).

Tamil Nadu through the ages, has been recognized as a prominent centre with high bio-diversity in rice crop. There are extensive mentions of varieties of rice in various kinds of literature and technical texts. At national and international level, in the recent times, the land races are being preserved in the gene banks. The trend towards health conscious, has made to re-look the traditional varieties with experiencing an increasing trend among consumers and the profitable market is reversing and focusing towards traditional varieties, due to their incredible health benefits *viz.,* the traditional varieties possess low sugar content, making them pleasing choice for consumers who are suffering from diabetics, overweight, or regulating their sugar intake. They have higher amount of glutamic

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acid, fiber and vitamins. Some views also credit traditional varieties with other health benefits, such as giving sensations of cooling in the body, improves vocal clarity, eyesight, fertility and mitigating rashes. Owing to several health-promoting impacts associated with anthocyanins, such as anti-oxidative, anti-inflammatory and anti-carcinogenic effects, colored rice is considered as a functional food and food ingredient in many Asian countries. The functional property of anthocyanins in red and black rice varieties has been verified and is with numerous nutritional aspects (Ashraf and Lokanadan, 2020).

Historically, farmers have conserved and cultivated a large number of traditional paddy varieties since they serve, several purposes -suited to certain pockets, depending on the local climate and soil type, they have a high degree of resistance to pests and diseases and they are known to have specific nutritional and therapeutic properties. There are several community based organizations in India and South Asia that are conserving traditional varieties of seeds. Indigenous paddy varieties are important since they have a range of agronomic properties that are suited to various locations, ecosystems, rainfall patterns, availability of water *etc* (Ashraf and Lokanadan, 2022).

Present research and future scope

Apart from being staple grain among cereals, currently, rice is also regarded as a neutralceutical and functional food besides being a common source of food and primary source of carbohydrate/starch in the diet. Its role of having low glycemic index in comparison to other genetically modified rice varieties, which containing complex carbohydrates, regarded as high glycemic index and as a food provide a better novel substitute for diabetic patients (Leena, 2004). Presence of valuable mineral content, excellent starch characteristics, antioxidant and anti-inflammatory activity represent these uniqueness among cereal sources and starch of these rice types is almost completely absorbed by human body. Scientifically, it has been proved, that amino acids possessed by these varieties have high biological value, high content of essential fatty acids and seleniumand have anti-hypertension effect. Hence, rice is now moving towards and is regarded as functional food. Rice extracts have been validated in inhibiting chloride channels in human body and thus reduce intestinal losses' in acute diarrhea, thereby serving as oral rehydration solutions (ORS) (Ashraf and Lokanadan, 2022). These rice based ORS are now preferred than glucose based ORS, as reported by World Health Organization programmes and projects. Rice due to its least allergic properties are recommended for patients suffering from irritable bowl syndrome. Colored rice varieties have been reported to possess antioxidant properties and considered more nutritious, being rich in iron (Fe), Zinc (Zn) and minerals. The zinc and iron content of red rice is two-three times higher than that of white rice (Ramaiah and Rao, 1953). These rice have been found to reduce atherosclerotic plaque by 50 per cent more than the white rice as seen in clinical trials with rabbits conducted in USA and have concluded that red rice reduces cholesterol and total triglycerides, providing a novel food based approach to lowering cholesterol (www.agrariancrisis.in /2012). Rice thus meet most of the requirements of a good and healthy food and is the only cereal that is eaten as whole grain, which according to Ayurvedic texts is more easily digestible than flour made from other cereals. A survey conducted by the National Bureau of Plant Genetic Resources, NBPGR from 1991 to 1998 recorded about 35 per cent and 21 per cent of rice as traditional red rice varieties in Orissa and Manipur (Krishnamurthy and Sharma, 1970; Dikshit *et al.,* 2004).

Bio-diversity of traditional rice varieties

Well-known Indian rice researchers, Richharia and Govindasamy, have reported in their book "Rice of India" which provides Vedic and present day literature evidence to show that the country has been endowed with more than 2 lakh (2,00,000) rice varieties, a rich biodiversity that no other country on earth possesses (Ashraf *et al.,* 2015). Rice can be grown even in certain environmental conditions where other crops cannot grow. In India, varieties of paddy, can be cultivated throughout the year. Paddy can grow at an altitude of 7000 feet above sea level. It can also grow at an altitude of 10 feet below sea level Cleveland *et al.* (1993, 2000). Arumugasamy *et al.* (2007) and Sathya *et al.* (2007) reported that there are paddy varieties, which can grow even if the annual rainfall is 500 mm and also varieties that can with stand even 5000 mm of annual rainfall. *Samhitas* of the *Yajurveda* mention about different varieties of grains such as *Vrihi, Yava, Masha, Tila, Mudga, Khalavarsha, Godhuma, Masura, Syamaka, Priyangu, Menava* and *Nivara*. Regarding the varieties of rice mentioned, prominent are hill paddy and deep water red rice varieties as mentioned in the Jatakas. *Udaraka* and *Varaka* are new varieties of rice introduced during Mauryan rule in India (Ashraf *et al.,* 2015a).

Rice landraces in Tamil Nadu

Nearly 400 varieties of landraces of paddy had been in vogue during olden days in Tamil Nadu. *Pallu pattu*, an ancient Tamil literary work on peasants, refers to about 150 varieties of paddy, more than one hundred different varieties of rice had prevailed in North Arcot district of Tamil Nadu alone. The remarkable kind of paddy in North Arcot district which warrants a special mention is Munagada (submerged). It has been grown in a few localities, in the beds of tanks before they are covered with water column. As soon as it sprouts well, it can survive though submerged below water as much as 3 feet. The stem is as thick and strong as the stalk of *cholum* (sorghum) but the grain is coarser and hence has not been preferred for consumption (Ashraf *et al.,* 2023).

1. Rice Landraces found suited to specific types of soil: The varieties that can be cultivated in clayey soil are

Kaliyan samba; *Samba mosanam* and varieties cultivated in sandy soil are *Kitchili samba, Kullakar, etc*.

2. Rice Landraces having resistance to pests and diseases: The *Neelam samba* variety is resistant to brown plant hopper; paddy ear head bug and varieties resistant to many pests and diseases are *Kudhiraival samba, Kurangu samba etc*.
3. Rice Landraces with varied amounts of water availability: Some of the drought resistant varieties are *Vadan samba* and *Kullakar*; flood resistant varieties are *Samba mosanam, Kudhiraival samba etc*.
4. Rice Landraces that are important in disaster management.

a) *Kappakar* for Food Security: *Kappakar* paddy land race is usually cultivated in clayey soil as a dry sown crop during the Samba (July - January) season. The duration of this crop is 5 months.

b) *Samba Mosanam* land race is ideal for Waterlogged Fields. The variety is also called *Puzhudikal, Erinel* and *Maduvumuzhungi* in Tamil. It is suitable for cultivation in the vicinity of lakes. It is said that people travelled by boats and harvested the *Samba Mosanam* in the lakes.

c) *Karunguruvai* Rice land race is an indigenous paddy type and can be cultivated during *Kuruvai* (June 1 - August 31) and *Navarai* (December 15 - March 14) crop seasons. The crop grows well on clayey, coarse and sandy clay soils to a height of 95 cm with crop duration of 120-125 days. It is used in siddha medicine to cure Filariasis, a disease caused by mosquito (Arumugasamy *et al.,* 2007).

d) *Kalarpalai* and its importance in tsunami disaster :During the tsunami disaster in the year 2004, thousands of hectares of land under paddy in the coastal regions of Nagapattinam district were immersed under sea water for various periods ranging from 20 -120 minutes. After the withdrawal of the water, the soil was rendered saline and became unfit for the cultivation of several modern and hybrid paddy varieties. However, one indigenous paddy *Kalarpalai* which was traditionally considered suitable for saline soils could grow and provide reasonable yields in tsunami affected lands. Similarly an indigenous paddy variety from the Gorakhpur region of Uttar Pradesh called as *Kalanamak* , traditionally found suitable for saline soils and could grow well in the affected area (Ashraf *et al.,* 2015a).

The yield potential of traditional rice landraces

When the water supply is adequateand naturally occurring nitrogen fixing organisms exist in the paddy fields, no synthetic fertilizers are required to produce upto 2 t ha^{-1} of the local variety of rice. Characteristics that determine the yield potential of rice cultivars are the number of “productive” tillers per hill and panicle density (number of grains per panicle and grain weight). Many native varieties have greater mean panicle density and grain weight than most HYVs. The maximum thousand grain weight upto 29 g. The yield in rice crop is calculated as production of grains per unit of inputs of water and agrochemicals. In respect to these aspects most of the local landraces have better yield than any HYVs reported by Cleveland *et al.* (1993). *Red Kavuni* rice landrace variety recorded enhanced growth characters and yield attributes (Ashraf *et al.,* 2017a, 2017b, 2017c, 2017d).

The climate resilient landraces

The rice landraces, due to their adaptability to different agro climatic conditions, unique characteristics and specific use are confined to only certain rice growing areas in particular season, to need to study the performances of rice landraces under different agro climatic zones and seasons. This rice is importance for biotic and abiotic stress, flood (submergence), heat, saline and drought. *Ch*and*ikar*, *Kuliyadichan*, *Kuruvaikalanjiyam*, *Norungan*, *Nootripathu*, *Black Kavuni*, *Red Kavuni*, *Njavara is* found to be a better agronomic option for obtaining higher growth and physiological characters, contributing to higher grain and economic yield (Ashraf and Lokanadan, 2020).

The nutraceutical properties of rice landraces of India

The presence of flavonoids and anthocyanin content together with high radical scavenging activity. The presence of polyphenols in the varieties, which favors the health conscious consumers. The DPPH (diphenyl-picrylhydrazyl), FRAP, ABTS radical scavenging activity higher in coloured rice due to presence of natural antioxidants (flavonoids, polyphenols (phenolic acids), anthocyanin and pro-anthocyanidin content. These qualities and properties would find favour with health conscious consumers. It is high time that people in India took a fresh look at similar properties in the vast pool of indigenous red rices. Clinical validation of these varieties is mandatory, so that the product from these excel in the international market. The glycemic index value of *Karuppu Kavuni, Kullakar*, *Kattuyanam* and *Chinnar* were in the range of 50-55 (Traditional rice varieties of Tamil Nadu: A source book). The speciality treatment from Kerala based on the preparatory procedure of *Panchakarma* therapy. It is practiced in neuromuscular disorders such as hemiplegia, paraplegia, muscular dystrophy *etc.* Oleation to head and body using special cloth pieces containing a smooth paste of *Njavara* rice cooked in *Sida* (*Sida rectusa*. Lin.) decoction and milk makes the body supple, removes stiffness of joints, cleans the body channels and brings about better blood circulation (Nair *et al.,* 2004). Red rices have the greatest average with respect to inhibitory property against colon cancer. They are few variable purple rice lines exhibiting anti-cancer properties. The flavonoids possess the remarkable ability to bind to cancer receptors, effectively inhibiting their activity and including a process known as apoptosis. With respect to nutritive and medicinal properties, *Black Kavuni* recorded higher phenol content, protein content and β-carotene when compared to other varieties (Ashraf and Lokanadan, 2022a).

Traditional rice varieties in siddha text (Table 1)

There are rice varieties mentioned in the book *'Siddha maruthuva thogai agharathy'* a Publication of Tamil University, Thanjavur and is given in the following table with the properties of key varieties of rice as described in the *Siddha* literature (Fig 1).

Special characters with medicinal and therapeutic value of rice landraces (Table 2)

- ***Karuppu Kavuni*:** It emperors/forbidden rice. It controls diabetes, hypertension, prevents cancer, reduces bad cholesterol, improves eyesight and it is wonderful detoxifier for liver. Lower yielding, tillering as poor, long duration photosensitive, brownish black kernel, Crop duration 130-135 days. The therapeutic potential of *Kavuni* was studied by Valarmathi *et al*. (2014) (Fig 2).
- ***Kullakar*:** It reduces the body mass index and acts as cardio tonic. Crop duration 90-105 days (Amudha *et al*., 2023)
- ***Kattuyanam*:** This variety grows very tall that even an elephant can hide inside cultivated area. It reduces the cholesterol and the heart related risks. It enhances the digestion. It is Porpulary called as the enemy of diabetes. This variety of paddy will withstand drought and flood, has self-immunity from pest attack and will grow to the height of 6 feet and be ready for harvest in 180 days.
- ***Chinnar***: The 'Chinnar' is such a landrace of rice grown in Madurai region of Tamil Nadu that contains thiamine, riboflavin, calcium, vitamin D, high fibre and glutamic acid along with higher content of anthocyaninand having antioxidative, anti-inflammatory and anti-carcinogenic properties. The traditional rice landrace contains numerous

Table 1: Traditional rice varieties in Siddha text (*Siddha maruthuva thogai agharathy'*).

1	*Kuruvai*	11	*Milaghu Samba*	21	*Sirumaniyan*
2	*Aanaikomban*	12	*MosanamNariyan*	22	*Eesurakovai*
3	*Kadambu*	13	*Navarai*	23	*Karunaivellai*
4	*Kalinga Samba*	14	*Neela Samba*	24	*Champa*
5	*Kaar*	15	*Neervellai*	25	*Thillai*
6	*Kalundai*	16	*Otadan*	26	*Thiruvaangam*
7	*Katraazhai*	17	*Pisaanam*	27	*Thuyyamalli*
8	*Madangal*	18	*Pisisni*	28	*VariChampa*
9	*Manikathai*	19	*Poombaalai*	29	*VaadaiChampa*
10	*Manavaari*	20	*Kaadaikazhuthan*	30	*Vellaimilagu*

(Ashraf *et al.,* 2024).

Fig 1: Genetic diversity of rice landraces (Whole grains and Dehusked rice).

Table 2: List of rice traditional landraces.

S.No	Rice land race	S.No	Rice land race	S.No	Rice land race
1	*Aathur kichali*	51.	*Kattuyanam*	101.	*Puzhuthikal*
2	*Adukku nel*	52.	*Kitchili samba*	102.	*Raja poga*
3	*Ambemohar*	53.	*Kochin samba*	103.	*Rajamanar*
4	*Anaikomban*	54.	*Kollikaar*	104.	*Rajamudi*
5	*Anandanoor sanna*	55.	*Kona kuruvai*	105.	*Ramakalli*
6	*Arcot kitchili*	56.	*Koomvazhai*	106.	*Rasakadam*
7	*Arikiravi*	57.	*Kothamalli samba*	107.	*Sadakaar*
8	*Arupatham kuruvai*	58.	*Kottara samba*	108.	*Salem samba*
9	*Arupatham samba*	59.	*Kottarai samba*	109.	*Salem sanna*
10	*Basmathi*	60.	*Kowni*	110.	*Samba*
11	*Bayakundathan*	61.	*Kudaivazhai*	111.	*amba mosanam*
12	*Cochin samba*	62.	*Kullakaar*	112.	*Sanaki nel*
13	*Cuddalore seeraga samba*	63.	*Kumsala*	113.	*Sandikaar*
14	*Eravai pandi*	64.	*Kunthali*	114.	*Sanna samba*
15	*Garudan samba*	65.	*Kuruvai*	115.	*Seengeni*
16	*Ghamgaadale*	66.	*Kuruvai kalangium*	116.	*Seeraga samba*
17	*Ghan sal*	67.	*Kuruvikar*	117.	*Seeraga sanna*
18	*Gunaparuva*	68.	*Kuzhiyadichan*	118.	*Selam samba*
19	*Ilupaipoo samba*	69	*Madumuzhugi*	119.	*Selam sanna*
20	*Iravai Pandi*	70.	*Mapillai samba*	120.	*Sempalai*
21	*Jawadhu malai nel*	71.	*Mathimuni*	121.	*Sempeli panni*
22	*Jeeraka sala*	72.	*Mottakuur*	122.	*Sengini*
23	*Jil jil vaigunda*	73.	*Mozhi karuppu samba.*	123	*Sigappu germani*
24	*Jiljeera*	74.	*Mundan kayama*	124.	*Sigappu kowni*
25	*Kalanamak*	75.	*Murkankaar*	125.	*Sigappu kuruvikar*
26	*Kacha koomvazhai*	76.	*urugakar*	126.	*Soolai kuruvai*
27	*Kadaikazhuthan*	77.	*Muttakaar*	127.	*Sooran kuruvai*
28	*Kaivara samba*	78.	*Namazhvar kuruvai*	128.	*Sornavari*
29	*Kala jeera*	79.	*Navara*	129.	*Sulaikuruvai*
30	*Kalarpalai*	80.	*Neelam samba*	130.	*Suran kuruvai*
31	*Kaliyan samba*	81.	*Norungan*	131.	*Thanga samba*
32	*Kallundai*	82.	*Ona mattan*	132.	*Thavalaikanna matta*
33	*Kallurundai*	83.	*Orissa vasanai; Seeraga samba*	133.	*Thengaipoo samba*
34	*Kallurundaiyan*	84.	*Ottadai*	134.	*Thirupathi saram*
35	*Kamban samba*	85.	*Ottu kitchili*	135.	*Thooyamalli*
36	*Kanali*	86.	*Paal thondi*	136.	*Thulasi vasanai; Seeraga samba*
37	*Kandasali*	87.	*Paal veliyan*	137.	*Vaadan samba*
38	*Kappakaar*	88.	*Pal kudaivazhi*	138.	*Vaikunda*
39	*Karikalava*	89.	*Panankaattu kudaivazhai*	139.	*Valan nel*
40	*Karunseeraga samba*	90.	*Patchai perumal*	140.	*Vallarakkan*
41	*Karungkuruvai*	91.	*Pattaraikaar*	141.	*Varappu kudainchan*
42	*Karunseeraga samba*	92.	*Perum koomvazhai*	142.	*Vasanai seeraga samba*
43	*Karuppu kowni*	93.	*Perungkaar*	143.	*asara mundan*
44	*Karuppu seeraga samba*	94.	*Pisini*	144.	*Veethivadangan*
45	*Karuthakaar*	95.	*Podaperunel*	145.	*Veliyan*
46	*Katcha koomvazhai*	96.	*Polinel*	146.	*Vellai kudaivazhai*
47	*Katta samba*	97.	*Poompalai*	147.	*Vellai kuruvikar*
48	*Kattu kuthalam*	98.	*Poongkaar*	148.	*Vellai milagu samba*
49	*Kattu samba*	99.	*Poovan samba*	149.	*Vellai poongkaar*
50	*Kattu vanibam*	100.	*Puzhuthi samba*	150.	*Vellaikkaar*

(Ashraf *et al.*, 2024).

medicinal properties that will help you stay energetic and young and primarily aid in the restoration of tumours in the body. It has less fat, less sugar, no gluten and the presence of oryzanol aids in the blocking of cholesterol in the body. As a result, this traditional rice variety is ideal food for diabetics and people with high blood pressure. Chinnar is a short duration cultivar and is ideal for rainfed and wetland conditions. It is also drought tolerant. Because the plants have purple- coloured leaves and culms, weed removal is simple. The grains are fine and long, with excellent cooking qualities (Kowsalya *et al*., 2022).

- ***Njavara:*** The white (yellow) variety is popular in the southern districts of Kerala, whereas in northern districts, the naturopathy practitioners use the black variety (Nair, 2004; Leena Kumary, 2004) (Fig 2).
- ***Annamazhagi*****:** It is very tasty to eat and is also healthy. It wards off many diseases and regulates the deranged Pitta.
- ***Irkku Samba*****:** It has a good look and taste and is liked by all. This is good for offering prayer and to feed the noble.
- ***Karunkuruvai*****:** This is a dark variety of paddy maturing in three months. Parboiled *karunkuruvai* rice wards of skin diseases, urinary tract diseases, poisonous stings and bites and promotes health.
- ***Kalundai Samba*****:** A kind of paddy yielding hard round rice, harvested after 200 days from planting. The one who take food made of this variety of rice gets the muscle strength of a boxer and this enhances the stamina and physical endurance. The rice is very tasty.
- ***Kaadai samba*****:** It provides strength to the body and makes the disease fly like Common Quail (*Coturnix coturnix*) particularly of the urinary tract like burning menturation and sensation.
- ***Kaalaan samba*****:** The name *Kalan* suggests the duration of the crop. If one consumes the food made of this rice at proper time aids in digestion of the previous meal, it provides enormous strength and also wards of diseases caused by formation of *Vaatha.*
- ***Kichili samba*****:** If properly cooked rice of this variety is consumed, it not only improves the physical strength but also enables weight gain, but also improves the complexion. This has a pale orange thin grain colour with pleasant aroma.
- ***Gundu samba*****:** It causes indigestion, skin diseases but controls thirst. In general it suppresses *Pitta*.
- ***Kundai samba*****:** It spreads excema, causes indigestion but controls thirst. The grain is stout.
- ***Kurunj samba*****:** The food made from this variety increases *Pitta*, dermatitis, but controls deranged *vaatha* and enhances libido. This is a late flowering variety with short grains.
- ***Kaivarai samba* :** It provides good strength and nourishes the body and is healthy. The name suggests the grain has linear marks like fingers.
- ***Kodai samba* :** It regulates all three *doshas* and therefore all diseases pass off like a passing cloud. This is paddy crop grown during summer. May be a drought resistant variety grown even in summer.
- ***Korai samba* :** It provides a cool feel and controls Pitta, it cures urinary tract diseases and controls pruritis. The straw is as hard as that of the nut grass.
- ***Seetha bogam* :** The verse says that it is cultivated and named after *Seetha*. If one consumes the *Seetha bogam* rice every day, it provides strength, complexion and improves spermatogenesis. It wards of indigestion.
- ***Seeraga samba* :** It is very tasty to eat and it regulates excess *vaatha*, easy to digest. It controls flatulence. The grains resembles cumin seeds.
- ***Chen samba* :** It controls excessive appetite, cures itching, pyoderma and wounds and this red rice is a preferred during feasts and important celebrations.
- ***Puzhugu samba* :** The variety is preferred by the farmers because of its ability to quench thirst and hunger and

Fig 2: Panicle view of some important medicinal rice landraces.

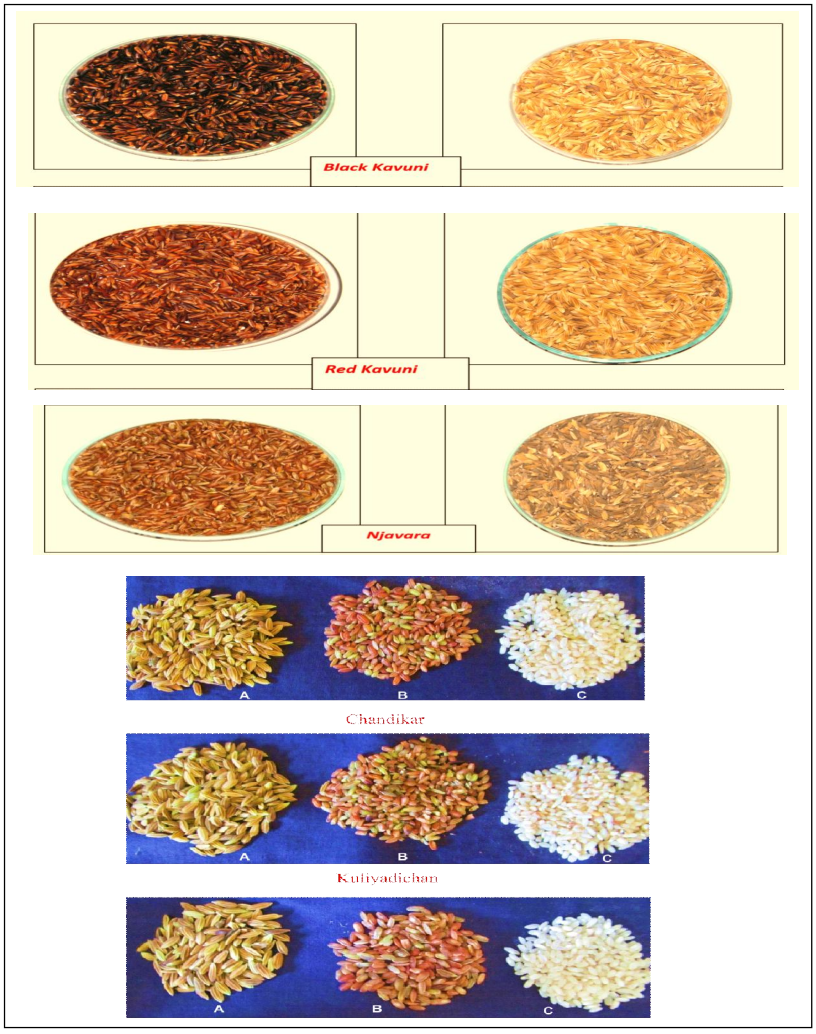

Fig 3: Genetic diversity of medicinal rice landraces (Whole grains, Dehusked rice and after milling).

strengthens the body, removes fatigue and provides a pleasant feel. This has the aroma of civet

- ***Mani samba*** **:** It is an ideal food for diabetic patients, growing children as well as elders. It is easy to digest. It is round in shape like a bead.
- ***Manakathai*** **:** It controls skin diseases, helps in poison bites, heals ulcers if one takes this variety regularly. This rice has the odour of pleasant smelling wood.
- ***Malligai samba*** **:** It is very tasty to eat, good for nourishment, strength and growth, prevents dermatitis. Burning sensation of the eyes subsides. The rice is pure white in colour like jasmine and has a pleasant aroma.
- ***Milagu samba*** **:** It improves appetite, regulates thirst, gives a pleasant feel, wards of many diseases. This is also a bead like (black pepper) rice variety.
- ***Mai samba*** **:** It regulates deranged *Vaatha* and *Pitta*, cures fever, vomiting, ingested toxins and removes ageusia and anorexia. This rice is dark black like the colour of eyeliner.
- ***Kundumani samba*** **:** It regulates deranged Vaatha and alleviates a lot of diseases.
- ***Valaithadi samba*** **:** It causes Vaatha and Pitta derangement, distention of abdomen due to flatulence, upsets digestion and causes skin eruptions. The grain has a curvature.
- ***Vaalaan arici*** **:** It suppress anorexia –loss of taste but improves complexion, adds weight. But in order to get proper nourishment and improve spermatogenesis have to be used judiciously (Fig 3).

CONCLUSION

The traditional rice landraces are healthy and also serve as functional foods. Due to emergence of high yielding varieties these have been replaced at a large pace and are posing the threat of extinction. Thus these varieties need to be conserved and promoted to commercialize and create general public awareness about their medicinal benefits. The presence of flavonoid and anthocyanin content, as well as higher radical scavenging activity and polyphenols, is beneficial to health conscious consumers. Clinical validation of these varieties is mandatory, so that the product from these excel in the international market. The

flavonoid and anthocyanin compounds are closely related to the antioxidation properties as found in black rice. It has been found that the DPPH (diphenyl-picrylhydrazyl) radical scavenging activity is higher in coloured rice and is correlated with polyphenols and pro-anthocyanidin content. These qualities and properties would find favour with health conscious consumers. It is high time that people in India took a fresh look at similar properties in the vast pool of indigenous red rices. Hence there is a need for us to revisit and reassess the value that has been attributed to traditional rice by exploiting cultivation of rice landraces for human health and food security in future.

Conflict of interest

The authors have no conflicts of interest to declare.

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