**Food and therapeutic values of Indian pigmented rice varieties**

**Bakiya Lakshmi SV1, Kalaivani R2, Boominathan M3, Aarthi A4**

1,2,3Department of Biotechnology

Bon Secours College for Women, Thanjavur

Department of Botany

[Kunthavai Naacchiyar Govt Arts College for Women (Autonomous), Thanjavur](https://www.kngac.ac.in/)

Affiliated to Bharathidasan University, Tiruchirappalli

E.mail: [bakiyalakshmi.sv@gmail.com](mailto:bakiyalakshmi.sv@gmail.com), [vanisri05bio@gmail.com](mailto:vanisri05bio@gmail.com), boomi\_26@yahoo.com

**Abstract**

Rice is a prime cereal crop that is fed on as a staple meals by way of over 1/2 of the sector’s populace. India is one of the predominant centers of rice manufacturing. Rice is rich in genetic range, with thousands of types grown international, and India is home to 6000 sorts. in the beginning, India had greater than one hundred ten,000 forms of rice till 1970, which have been lost at some stage in the inexperienced Revolution, with its emphasis on monoculture and hybrid vegetation. The kings of Tamilnadu especially in Chola’s periods there are a lot of rice varieties like *Ottan samba, Patchai Perumal, Attur Sambha and Kuruvai Kalanjiyam, karung kuruvai, Thuyamalli, Karuthakkar, Thanga Samba, Garudan Samba, Mappillai Samba, Poongaar, Kudavazhai, Pisini*, etc., were cultivated. The pigmented rice sorts contain the flavonoid compound anthocyanin that's liable for the shade of the rice. The traditional rice types possess unique bioactive compounds with medicinal properties like Antioxidant, Anticancer, Prevention of Sickle cell Anemia, Anticoronary, Antiinflammatory and Sexual Hormone production. This paper emphasized the rice variety could be a good genetic resource for developing rice cultivars with enhanced levels of health-promoting compounds in order to protect our health from devastating diseases and leads to a sustainable healthy life with high Nutraceutical potential.

**Keywords:** Traditional rice, Nutrients, Bioactive compounds, Pharamacology, Nutraceuticals

**Introduction**

Rice is a chief cereal crop this is consumed as a staple meals through over half of the arena’s population. Rice consumption is high in growing countries and Asian countries. almost 95% of rice is produced in Asian international locations, and about half of the world’s populace consumes it. Rice cultivation ranks 1/3 within the manufacturing of agricultural commodities, next to sugarcane and maize. India is one of the most important facilities of rice manufacturing. The place for rice cultivation in India contains about 43,388,000 hectares of land (Agricultural Statistics Division 2018 1), and rice contributes 780 and 689 kcal/capita/day of the food supply in Asia and India, respectively. Rice is rich in genetic diversity, with lots of varieties grown globally, and India is domestic to 6000 varieties. originally, India had greater than 110,000 kinds of rice until 1970, which had been misplaced during the Green Revolution, with its emphasis on monoculture and hybrid plants. In Tamil Nadu, the paddy is cultivated in 3.25 lakh acres, and the yield is anticipated to be around 5.60 lakh tonnes in 2020.

**Nutritional properties of Pigment rice**

The nutritional value of the rice varies depending on several elements, such as the stress or variety (i.e., white, brown, purple, and black/crimson), nutrient quality of the soil wherein rice is cultivated, degree of milling, and method of preparation before intake. A examine of 230 rice types international showed that Indian rice is within the recommended Glycemic index.

Attur Sambha and Kuruvai Kalanjiyam comprise very small concentrations of amylose (13.6%) and (17.7%, respectively), while Thooyamalli carries very excessive quantities of amylose (26.24%), that is, a fivefold boom in this specific range. Amylose content ranged from 13.6% to 26.24% (Keerthivarman et al. 2019). Brown rice is a incredibly nutritious crop. It has low energy and a excessive quantity of fiber, excellent supply of magnesium, phosphorus, selenium, thiamine, niacin, and diet B6, and an great source of manganese.The medicinal rice Kullakar and Karikalaveya have high thiamine, riboflavin, and niacin content (Isaac et al. 2012).

**Phytochemical compounds in rice varieties of Tamil Nadu**

The pigmented rice Mapillai samba showed the highest vitamin E content as compared to Iluppai poo samba rice, Kala namak rice, and Kuzhiyadichan (Rajendran et al. 2018). general phenolics content Phenolics are a set of herbal antioxidants which have acquired huge interest for their pharmacological functions. a few of the phenolic acids, ferulic and ρ-coumaric acids are ample in grains with light brown pericarps, whereas purple and black pericarp rice carries specially anthocyanins cyanidin-three-O-β-d-glucoside and peonidin-three-O-β-d-glucoside]. higher TPC was found for Kalanamak 43.19±zero.54 mg/100 g, Mapillai samba 39.56 ± 0.50 mg/100 g, Iluppai poo samba 34.61±zero.75 mg/100 g and the lowest become with Poongar variety 10.23±0.22 mg/100 g (Fig. 3). most of the rice varieties examined, the pigmented varieties showed statistically great values for overall phenolic content in comparison to that of non-pigmented varieties, which includes Salem sanna, Seeragasambha, and Madumuzhungi.

Pericarp shade pigments are derived from polyphenols, and the type and concentration of such polyphenols inside the grain range amongst genotypes. Plant phenolics like isoflavonoids and stilbenes have been determined to be useful to human health. Flavonoids can counteract cancer cell growth and sell antioxidant antiinflammatory activity. General Anthocyanin pigments were suggested to be incredibly potent in decreasing cholesterol levels inside the human body.

the total anthocyanin content material was found to be the best in pigmented sorts (Fig. 3), Mapillai samba 42.21±0.28 mg/100 g, Kalanamak 34.01±0.45 mg/100 g, Iluppai poo samba 28.27±0.26 mg/100 g and lowest anthocyanin content became located in non-pigmented rice variety Kuzhiyadichan 11.12 ±0.18 mg/100 g, respectively. The most important flavonoids in pigmented rice sorts are anthocyanins and kaempferol, which had been identified because the dominant flavonols, while apigenin was the foremost aspect of flavones.

Mappillai Samba, a type of red rice from Tamil Nadu, has the best quantity of total polyphenolic compounds and anthocyanin content as compared to the types from Sri Lanka, China red rice, and Manipur black rice. Phytochemicals, including cellular wall-sure phenolics and flavonoids, are gaining greater interest, as these compounds can be broken down by digestive enzymes and intestine microflora, which enables easily absorbed into the body (Chen et al. 2013).

Rice bran and husk contain excessive amounts of calcium, zinc, and iron. Pigmented rice bran carries anthocyanins that inhibit reductase enzymes and feature antidiabetic sports (Yawadio et al. 2007). Reductase inhibitors own anti-androgen consequences and are used within the remedy of benign prostatic hyperplasia and decrease urinary tract symptoms. β-Sitosterol, found in Maappillai Samba, has a hypocholesterolemic effect, improves fertility, and ameliorates colon cancer. furthermore, stigmasterol, discovered in this range, is a precursor for the manufacturing of semisynthetic progesterone (Sulochana et al. 2015). Garudan Samba incorporates 9, 12-octadecadienoic acid (Z, Z), which has the potential to act as a hypocholesterolemic, anti-arthritic, hepatoprotective, five-alpha-reductase inhibitor, anti-histaminic, anti-coronary, and anti-androgenic agent. similarly, they include numerous bioactive compounds (Sulochana et al. 2016).

Three-Cyclohexene-1-methanol and α, α, 4-trimethyl- present in red Kavuni possessed antimicrobial activity, and three-hydroxy-four methoxy benzoic acid became used as a precursor for the synthesis of morphine. in addition to those compounds, fatty acid esters and fatty acids, inclusive of dodecanoic acid, ethyl ester (lauric acid ester), and octadecanoic acid, are present. among these bioactive compounds, octadecanoic acid and ethyl esters increase the low-density lipoprotein (LDL) cholesterol levels within the human body (Sulochana et al. 2016). Likewise, n-hexanoic acid, n-dodecanoic acid, n-octadecanoic acid, and n-eicosanoic acid were determined in the traditional rice Seeraga samba.

The compounds 9, 12, 15-octadecatrienoic acid-2, three-dihydroxy propyl ester, sitosterol, squalene, and ethyl iso-allocholate have been found in kavungi rice have antimicrobial hobby. similarly, different phytochemicals along with tetradecanoic acid, hexadecanoic acid, cis-vaccenic acid, eicosanoic acid, and tocopherol are also found in Karungkavuni rice, which possesses rich pharmacological pastime (Malathi et al. 2016). Brown rice consists of 8 phenols, protocatechuic acid, p-coumaric acid, caffeic acid, ferulic acid, sinapic acid, vanillic acid, methoxycinnamic acid, and tricin, and decreased colony formation in SW 480 colon and MDA MB 468 breast cells. Caffeic acid reduced the range of all cellular types except HBL a hundred. Tricin, ferulic acid, and methoxycinnamic acid intrude with viability of one or extra mobile lines (Hudson et al. 2000).

**Medicinal uses of pigmented rice**

In line with Ayurveda, rice balances the humor of the body. Rice enriches elements of the body and strengthens, revitalizes, and energizes the frame via casting off poisonous metabolites, regulating blood strain, and preventing skin sicknesses and untimely getting old. Rakthasali (a form of red rice) is green in subduing disturbed humors of the body and is ideal for pyrexia, peptic ulcer, improves imaginative and prescient of the attention, protects the skin, and increases fertility (Bhat et al., 2015; Kumar, 1999). Ayurveda, Sali, Sashtika, and Nivara rice are used to treat bleeding from hemorrhoids (piles). Sali rice is used to deal with bone fractures; Nivara rice is used to deal with cervical spondylitis, paralysis, rheumatoid arthritis, neuromuscular issues, psoriasis, skin lesions, reduce backache, stomach ulcers, and snakebites, and is likewise used within the preparation of weaning meals for underweight infants (Bhat et al., 2015; Kumar, 1999).

In Ayurvedic arrangements, rice varieties such as Mahagandhak ras, Kamdudha ras, Sutsekhar ras, Amritanav ras, Swarnmalti ras, Pradraripu ras, Laghumai ras, Dughdavati, Pradaknasak churna, Pushpnag churna, Sangrahat bhasm, and Mukta sukti are used to control illnesses, consisting of vaginal and seminal discharges, diarrhea, constipation, and dysentery (Bhat et al., 2015). Red rice types are used as remedy of illnesses such as diarrhea, vomiting, fever, hemorrhage, chest pain, wounds, and burns (Hedge et al. 2013). Matali and Lal Dhan are used to curing blood stress and fever in Himachal Pradesh. another crimson rice range, Kafalya from the hills of Himachal Pradesh and Uttar Pradesh, is used to deal with leucorrhea and headaches from abortion (Ahuja et al. 2005). Neelam Samba of Tamil Nadu has been used to increase the variety of lactating moms (Arumugasamy et al. 2005). Raktasali is a great treatment for fevers and peptic ulcers, improves eyesight and voice, acts as a diuretic and spermatophytic, and has an antitoxic impact (Kumar 1999, Bhat et al., 2015). crimson rice varieties, which includes Bhama, Danigora, Karhani, Kalmdani, Ramdi, Muru, Hindmauri, and Punaigora of Jharkhand and Chattisgarh, are wealthy in nutrients and provide power (Ahuja et al., 2008). Traditional rice possesses antidiabetic, antinflammatory, gastrointestinal sickness, diarrhea, and diuretic properties (Burlando and Cornara 2014; Umadevi et al. 2012).

**Food formula from traditional rice sorts**

Koliyal and Garudan Samba (Kaadai Kazhuthaan) from Tamil Nadu were used to put together a specialty dish called puttu (Sulochana et al. 2016). Arun (2019) formulated a meals recipe inclusive of Mapillai samba rice kheer, black kavuni rice pan cake, bamboo rice kolukattai (modak), Navara rice laddoo, and Rose matta rice kesari, which possess rich vitamins together with calcium, phosphorous, iron, and protein, and are used to deal with anxious problems and excessive glycemic index (Mattoo 2019), which reduces the accumulation of hepatic fats and facilitates to get better liver harm (Jang et al. 2012). Black rice is wealthy in antioxidants that help combat most cancers and cardiovascular diseases. Likewise, the nutraceutical dosa blend turned into prepared using Navara rice, that is rich in vitamins and bioactive compounds which can be used to treat cancer, arthritics, and cardiac-associated illnesses (Sulochana and Bakiyalakshmi 2011). Kalaivani et al. (2018) prepared nutraceutical-formulated products from karung kavuni rice owning antioxidant, hyphocholestermic, hepatoprotective, antinflammatory, most cancers-preventive, and antimicrobial compounds. nowadays, the spotlight is at the expanded production of these conventional sorts, selling intake a number of the more youthful era and the manufacturing of nutritious and novel cost-brought products from pigmented rice.

**Perspective**

Even though India is domestic to traditional purple rice types, and their use has been common amongst practitioners of conventional medication and groups as a part of their cultural history, their functional outcomes and health benefits in terms of contemporary medical method are very few. Due to the inadequate availability of statistical data, the beneficial properties of those sorts stay unknown to most people of the population. consequently, to leverage their fitness advantages, significant studies on these local-pigmented varieties by stakeholders have to be promoted in order that they're available to customers as a part of their each day diet or distinctiveness purposeful ingredients. It’s our prime responsibility to conserve and domesticate conventional medicinal rice so as to guard our health from devastating illnesses and results in a sustainable healthy life with high Nutraceutical capability.

Reference

1. Agricultural Statistics Division, Third advance estimates of production of food grains for 2016-17, Department of Agriculture, Cooperation and Farmers Welfare, India. 3rd\_ Adv\_Estimates2016-17\_Eng.pdf. Accessed 2018.
2. Keerthivarman , S. Juliet Hepziba , R.P. Gnanamalar and J. Ramalingam. Characterization of rice (Oryza sativa L.) landraces based on agromorphological traits. Electronic Journal of Plant Breeding, 10 (2): 627-635 (2019).
3. Isaac, R.S.R.; Nair, A.S.; Varghese, E.; Chavali, M. Phytochemical, antioxidant and nutrient analysis of medicinal rice (*Oryza sativa L*.) varieties found in south India. Adv. Sci. Lett. 11, 86–90 (2012).
4. Chen C-H, Yang J-C, Uang Y-S, Lin C-J. Improved dissolution rate and oral bioavailability of lovastatin in red yeast rice products. Int J Pharm. 444(1-2):18–24 (2013).
5. Yawadio R, Tanimori S, Morita N. Identification of phenolic compounds isolated from pigmented rices and their aldose reductase inhibitory activities. Food Chemistry. 101(4):1616–25 (2007).
6. Sulochana S, Meyyappan RM, Singaravadivel K. Phytochemical screening and GC-MS analysis of Garudan Samba traditional rice variety. Int J Environ Agri Res. 2(4):44–7 (2016).
7. Sulochana S, Singaravadivel K. A study on phytochemical evaluation of traditional rice variety of Tamil Nadu -'Maappillai Samba' by GC-MS. International Journal of Pharma and Biosciences.6(3):606–11 (2015).
8. Malathi K, Anand Anbarasu and Sudha Ramaiah. Ethyl Iso-allocholate from a Medicinal Rice Karungkavuni Inhibits Dihydropteroate Synthase in Escherichia coli: A Molecular Docking and Dynamics Study. Indian J Pharm Sci;78(6):780-788 (2016).
9. [Hudson](https://pubmed.ncbi.nlm.nih.gov/?term=Hudson+EA&cauthor_id=11097223), [P A Dinh](https://pubmed.ncbi.nlm.nih.gov/?term=Dinh+PA&cauthor_id=11097223), [T Kokubun](https://pubmed.ncbi.nlm.nih.gov/?term=Kokubun+T&cauthor_id=11097223), [M S Simmonds](https://pubmed.ncbi.nlm.nih.gov/?term=Simmonds+MS&cauthor_id=11097223), [A Gescher](https://pubmed.ncbi.nlm.nih.gov/?term=Gescher+A&cauthor_id=11097223). Characterization of potentially chemopreventive phenols in extracts of brown rice that inhibit the growth of human breast and colon cancer cells. Cancer Epidemiol Biomarkers Prev. (11):1163-70 (2000).
10. Bhat FM, Riar CS. Health benefits of traditional rice varieties of temperate regions. Med. Aromat. Plants. 4:198 (2015).
11. Kumar TT. History of rice in India. Delhi, India: Gian Publishers; (1999).
12. Hedge S, Yenagi NB, Kasturiba B. Indigenous knowledge of the traditional and qualified Ayurveda practitioners on the nutritional significance and use of red rice in medications. Indian journal of traditional knowledge.12:506–11 (2013).
13. Ahuja U, Ahuja SC, Chaudhary N, Thakrar R. Red rices-past, present, and future. Asian Agri-History. 11(4):291–304 (2005).
14. Arumugasamy S, Jayashankar N, Subramanian K, Sridhar S, Vijayalakshmi K. Indigenous rice varieties. Centre for Indian Knowledge System (CIKS), Chennai: Tamil Nadu India; 66 (2001).
15. Ahuja U, Ahuja SC, Thakrar R, Singh RK. Rice- a nutraceutical. Asian Agri-History. 12(2):93–108 (2008).
16. Burlando, B.; Cornara, L. Therapeutic properties of rice constituents and derivatives (*Oryza sativa L*.): A review update. Trends Food Sci. Technol. 40, 82–98 (2014).
17. Umadevi, M.; Pushpa, R.; Sampathkumar, K.; Bhowmik, D. Rice—Traditional medicinal plant in India. J. Pharmacogn. Phytochem. 1, 6–12 (2012).
18. Arun. Formulation and Nutritional Assessment of Recipes En Route for Awareness of Coarse Rice. Protecting Rice Grains in the Post-Genomic Era. [8562](http://dx.doi.org/10.5772/intechopen.8562). 1- 13 (2019).
19. Mattoo S. Black Rice Is the Latest Super Food. Here's Why! Updated on January 05 [Internet] Cited on 2019 January 03. Available from: <https://timesofindia.indiatimes.com/> life-style/health-fitness/diet/Black-rice-is-the-latest-superfood-Heres-why/ rticleshow/50439583.cms (2016).
20. Jang H-H, Park M-Y, Kim H-W*.* Black rice (*Oryza sativaL*.) extract attenuates hepatic steatosis in C57BL/6 J mice fed a high-fat diet via fatty acid oxidation. Nutrition and Metabolism.;9(1):1 (2012).
21. Kalaivani,R, Arulmozhi P, S. V. Bakiyalakshmi . A Study on Medicinal Properties of Traditional Rice Karung Kavuni and Neutraceutical Formulation. Int J Food Nutr Sci 5(1): 86- 90 (2018).
22. Sulochana, S. Bakiyalakshmi, S.V. Effect of Neutraceutical Dosa on Antimicrobial Activity. Inter J Environ Sci 1(5): 727-735 (2011).