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Aromatic Rice: A Natural Gift Comes With High Price and Quality

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SUMMARY

Aromatic rice belongs to a small but important sub-group of rice, which is highly regarded for its excellent aroma and superior grain quality. Genetically, rice aroma is a phenotypical expression of spontaneous recessive mutations of the OsBadh2 gene which is also known as fgr/badh2/osbadh2/os2AP. The natural incidence of non-functional osbadh2 mutation along with selection and nursing by the farmer from the ancient time makes rice aroma as a prominent natural gift. The desirability of aroma in rice grains is one of the most highly valued grain quality traits which have resulted in strong human preference and selection for aromatic grains during domestication. Aromatic rice is rated quite higher and fetch greater premium price than high quality non-aromatic rice in world markets. However, inherently these are low yielding and suffer from various disadvantages such as lodging during maturity, susceptibility to various insect pests and diseases, etc.

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop in the developing world and accounts for the dietary energy requirements for almost half of the world population. It is primarily a high energy or high caloric food containing around 78.2% carbohydrate, 6.8% protein, 0.5% fat and 0.6% mineral matter. Considering its importance and position, the United Nation designated 2004 as the "International Year of Rice". Depending on the presence of aroma, rice is categorized into aromatic and non-aromatic rice. Usually the non-aromatic rice cultivars are exceptionally high yielding, manifesting better agronomic performances, and are remarkably suitable for different ecological situations and cultivated in almost all the rice growing regions. On the contrary, although most of the aromatic rice varieties are low yielding with inferior execution and enormously prone to adverse environmental conditions and are produced in few countries (Prodhan *et al*., 2017), they are hugely considered for their excellent aroma and superior grain quality. The Phylogenetic analysis mentioned that the genes responsible for aroma or fragrance of rice originate from wild relatives such as *Oryza nivara* and *Oryza rufipogon*, and the centre of origin is believed to be in the foothills of the Himalayas in Indian subcontinent from where it broadens its existences to different parts of the world. Notwithstanding, the aroma in rice varieties can be designated as a natural phenomenon which has been encouraged and persevered by the selection procedure. Customarily, the scented rice is admitted to be controlled by a major gene called *osBadh2* (*fgr*/*badh2*/*osbadh2*/*os2AP* gene) which has been mutated and expressed only at homozygous recessive conditions. Nevertheless, certain aromatic cultivars do not possess the mutated alleles of *OsBadh2* gene, demonstrating the presence of other genes or alleles responsible for their aroma. Aromatic rice is known for its nut like scent or aroma and taste due to the presence of a chemical compound 2-acetyl-1-pyrroline having medium to long grains. Apart from this chemical, other organic compounds, as well as oils and phenolics, are also likely to be involved. The conception of 'flavouring' rice was originated in Asia and gradually made its way to the United States and Europe.

Varieties:

Several important varieties of aromatic rice are Ambemohar, Basmati, Jasmine, Sona Masuri, Texmati, Tulaipanji, Tulshimala, Wehani, Gobindobhog and wild Pecan rice. When cooked, the grains have a light and fluffy texture except for Gobindobhog rice which is sticky in texture. Seven traditional scented varieties of aromatic rice beyond Basmati are listed below:


Ambemohar rice


Mullan Kazhama rice


Gobindo Bhog rice


Seeraga Samba rice


Mushk Budji rice


Radhuni Pagol rice


Chak Hao Amubi

- **Ambemohar:** It is a short grain rice variety which is cultivated more specifically in Maharashtra and popular for its quick cooking characteristics and beautiful aroma that is reminiscent of mango blossoms.
- **Mullan Kazhama:** *Mullan Kazhama* is an aromatic rice variety with an unconventional taste and aroma which is mainly found in Kerala's Wayanad district and utilized in *pal payasam* and Malabar biriyani.
- **Gobindo Bhog:** Gobindo Bhog, a small grained scented rice from West Bengal, is categorised as a *khaas dhan (*special grain) and widely used for auspicious offerings, pujas and festivals. It is known by this unique name as it is offered to Lord Krishna on Janmashthami by preparing extremely delicious *payesh or kheer*.
- **Seeraga Samba:** It is a much preferred slender rice variety in Tamil Nadu for its sublime scent and is extensively used to make pulav during special occasions as well as in two most iconic biryanis such as Dindigul biryani and Ambur biryani.
- **Mushk Budji:** It is mainly grown in the Kashmir valley and well known for its short grain with resplendent aroma.
- **Radhuni Pagol:** It is a culinary favourite in West Bengal but is little-known outside the state. It is a fragrant rice whose name literally translates to 'making the cook go mad'.
- **Chak Hao Amubi:** It is a scented variety of sticky black rice grown in the hills of Manipur and packed with high amount of anthocyanins, good for heart health and has a slightly sweet, nutty flavour that is exemplified in the Manipuri black rice *kheer*.

Response to Cultivation Process

Rice aroma or flavour and its quality are highly influenced by the cultural methods or cultivation practices along with environmental conditions *viz.* temperature, soil type, abiotic stress, water, CO_2, light, salinity, shading and so on. The organic amendment like poultry litter can produce grains having lower protein content with superior aroma; whereas high nitrogen fertilization produces grains with greater amount of protein and inferior aroma. Moreover, supplementation of N, P, Ca, Mg, Mn and Zn may improve 2-acetyl-1-pyrroline or 2AP content, although the maximum amount is documented with the application of two fold more phosphorus compared to the other nutrients. The proper timing of field drainage and harvesting considering physiological maturity, moisture content, and meteorological conditions can influence the aroma quality of rice. Basmati becomes more scented and expresses high quality grains whenever cultivated in the state Punjab in India as well as Pakistan, but produces low fragrance when produced in other countries. Correspondingly, Jasmine rice (KDML105) exhibits improved aroma in rainfed and drought stricken regions on dry and sandy soil especially in north and north eastern parts of Thailand. Aroma content declines with the maturity period and the best aroma with aroma score 3 is observed at 20 days after 50% flowering. On the other hand, low planting density or low population of plants and early harvesting can also improve aroma in rice. Additionally, the grains are overflowed with excellent scent when cultivated under relatively cool temperature range in the afternoon (25ºC–32ºC) and night (20ºC–25ºC) with relative humidity of approximately 70%–80% at primordial and grain filling stages (*Singh et al.*, 2000). These aromatic rice varieties are most probably very much susceptible to numerous diseases and pests, prone to various abiotic stresses, and highly responsive to photoperiodism.

Aromatic Rice Demand and Markets

Aromatic rice contains various bio-chemicals including the most significant one '2-acetyl-1-pyrroline' which imparts a pop corn or pandan (*Pandanus amaryllifolius*) like odour. In Asia, particularly in Thailand,

pandan extract is used in several Thai sweets to add flavour and makes aromatic rice highly desirable in particular countries. It is perceived as premium quality and fetches high prices in some international markets of South Asia, the Middle East, and India, Pakistan, and Thailand. For Indians, aroma is rated the highest desired trait followed by taste and elongation after cooking. The unique texture and aroma gives Jasmine rice from Thailand a perception of expensive quality among most Chinese and Taiwanese, whereas, the U.S. and Canadian consumers have higher fondness for long grained rice, Jasmine. Two prominent aromatic rice varieties in the international market include Basmati, cultivated in India and Pakistan, and Khao Dawk Mali or Jasmine rice, produced in Thailand.

Basmati rice

Jasmine rice

Jasmine rice is continuously being an important export commodity of Thailand which generates highest value of exports among all rice export commodities and since 2002, it has accounted for more than 20% in quantity and 30% in value of total rice exports. The export value and quantity of Basmati rice account for almost all rice exports from India and the major trade markets are Saudi Arabia, United Arab Emirates (UAE) and Iran which consider more than 70% of total Basmati exports. Though the exports of Basmati rice from India to Saudi Arabia, UAE, the U.K. and the U.S. have declined during past few years, exports to Iran, Kuwait, Yemen Republic, Iraq, Jordan, and Netherland have enhanced drastically which implies that not only the Middle Eastern countries have preferences towards Basmati rice, but their desires seem to increase in recent years.

CONCLUSION

Though aromatic rice contributes to a small share in the world market, at present, it is recognized with higher price than normal rice. Among quality attributes of milled rice such as amylose content, gelatinization temperature, gelatinize consistency, kernel length and breadth, shape, size, endosperm, kernel colour and kernel elongation, protein content, vitamins and minerals, aromatic attribute receives much attention in the breeding programs recently due to an increasing demand of importing countries towards aromatic rice. 2-Acetyl-1-pyrroline, a principal aroma compound has been detected in all aerial plant parts of scented rice but several other major volatiles such as hexanal, nonanal, octanal, (E)-2-nonenal, (E,E)-2,4-nonadienal, heptanal, pentanal, (E)-2-octenal, 4-vinylphenol, 4-vinylguaicol,1-octen-3-ol, decanal, guaicol, indole and vanillin contributing in the aroma have been identified. While the supply of aromatic rice does not meet its demand, consumers cherish it from paying the premium. Traditional aromatic rice producers, namely India, Pakistan, and Thailand, continue to be the leading developers of new evolved aromatic rice, and the best quality of traditional Basmati and Jasmine rice cultivars are attributed by their geographical origins.

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