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Yonhewa Kawya De Silva

Scientific supervisor: Associate Professor A. Litvinchuk

Educational Establishment
“Gomel State Medical University”
Gomel, Republic of Belarus

BIOCHEMICAL DEVELOPMENT OF AROMA AND FLAVOR OF RICE

Introduction

Rice is a staple food for more than half of the world’s population, and its aroma and flavor are key determinants of consumer preference and market value. Understanding the biochemical processes underlying the development of aroma and flavor in rice is essential for enhancing its quality and meeting the diverse culinary preferences of consumers.

Goal

The goal of this research is to investigate the biochemical pathways involved in the development of aroma and flavor in rice. Through comprehensive analysis of key compounds and enzymes, the aim is to elucidate the mechanisms underlying aroma and flavor generation during rice maturation. By understanding these processes, we seek to enhance rice breeding and processing techniques to produce varieties with superior sensory attributes, ultimately contributing to the improvement of rice quality and consumer satisfaction.

Material and methods of research

An online survey was conducted and based on the results from various countries including Sri Lanka (76.3%), Belarus (9.7%), Maldives (7.5%); Malaysia, United Kingdom, Qatar, United Arab Emirates and India (collectively 6.5%). Results were obtained from citizens from an age range of 13 years to 73 years. Many other well-known sources like WHO Foundation, ScienceDirect and NIC govt articles were also utilized.

The results of the research and their discussion

Instrumental analyses have found over 200 volatile compounds present in rice. However, little is known about the relationships between the numerous volatile compounds and aroma/flavor. A number of oxidation products have been tagged as likely causing stale flavor. However, the amounts of oxidation products, that need to be present for rice to have stale or rancid flavor have not been established. Only one compound, **2-acetyl-1-pyrroline (2-AP; popcorn aroma)** has been confirmed to contribute a characteristic aroma. Furthermore, 2-AP is the only volatile compound in which the relationship between its concentration in rice and sensory intensity has been established [1].

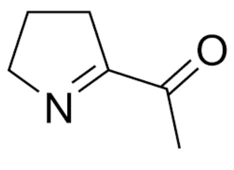

Figure 1 – The structure of 2-acetyl-1-pyrroline [4]

Generally, the aromatic rice cultivars are enriched with large volatile and semi volatile compounds, alcohols, aliphatic aldehydes, alkane, alkene, aromatic aldehydes, aromatic hydrocarbon, carboxylic acid, ester, furan, ketone, N-heterocyclic, phenol, and terpenes. Based on the rice genome sequence information, the *OsBadh2* gene (present on chromosome 8) is identified as a candidate gene for aroma, which is the most important aroma gene till now. However, several other genes and locus had been reported to be the contributor for aroma. Scented rices had been grouped into small, medium and long grained types based on grain length and could be categorized by their scentedness as mild and strong aromatic types. Broadly, the aromatic rice germplasm is grouped into three categories *i.e*. the Basmati, jasmine, and non-basmati/jasmine typed scented rice [2].

Taste is perceived by chemoreceptors within taste buds on the surface of tongue, while odor is assessed by chemoreceptors in the olfactory epithelium. Rice flavor studies to date have largely focused upon identification of the volatiles emanating from cooked rice and to a much lesser extent, the relative importance of individual compounds to the overall aroma. A number of volatile compounds have been detected and identified with GC-MS (Gas chromatography – mass spectrometry). For example, 64 volatile compounds were identified as emanating from a long-grain rice cultivar (e.g., seven alcohols, fifteen aldehydes, nine ketones, four ester, eight acids, ten aromatics, ten nitrogen compounds, etc.) The first steps in characterizing aroma are the identification and quantification of the volatile compounds emanating from cooked rice. A diverse cross-section of volatiles has been identified thus far (e. g., > 320), however, there has been tremendous variation in the compounds identified between studies. The variation appears to be largely due to differences in method of isolation and the type of rice analyzed. This is especially so in studies using steam distillation for collection in that volatile compounds with relatively high molecular weights and low vapor pressures were also identified [3]. Public preference stated better likeliness to medium grained rice as shown in Figure 2. This medium-grain rice only has its husk removed, with the bran and germ layer remaining. This means it is higher in dietary fiber and protein, as well as key nutrients like iron, vitamin B and magnesium [5].

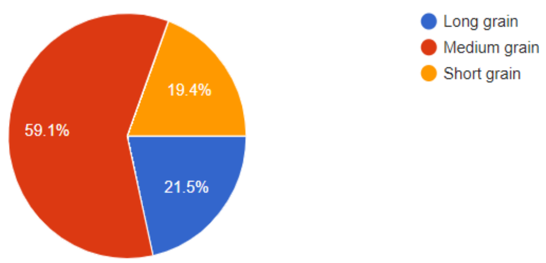

Figure 2 – Public preference on the different types of rice according to length

Rice has two types of starches, amylose and amylopectin. Amylose is a long, straight molecule that doesn't gelatinize while cooking, which means that rice with higher ratios of amylose will be fully separated and fluffy (think long-grain rice varieties like Basmati and Jasmine rice). Amylopectin is a highly branched molecule, meaning it has more ends sticking out that can stick together, aka many of our sticky rice or short-grain rice varieties [5]. According to the survey conducted, the majority of the population went by with white rice (as shown in Figure 3) as their main preference of daily and major consuming uses. The second on the list was Basmati rice which similar to white rice is long grained [6].

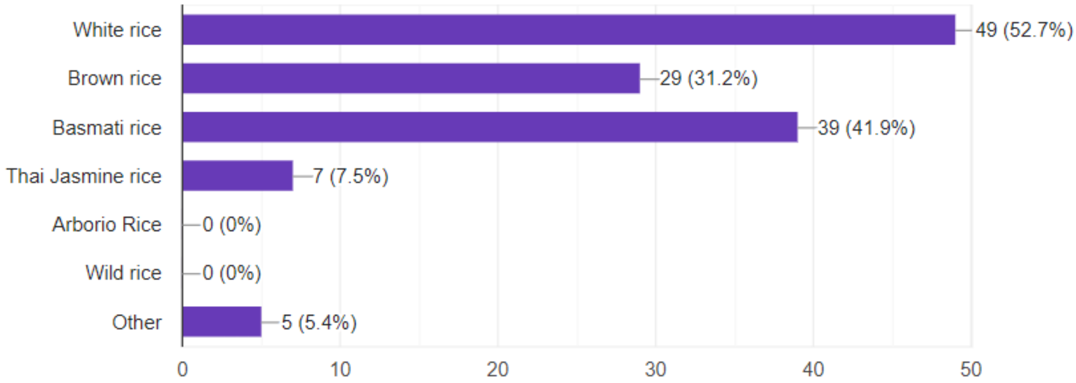

Figure 3 – Public preference on the different types of rice according to flavour

The characteristics of the flavor volatiles, and perhaps the characteristics of the odor itself, of freshly cooked rice after long-term storage significantly depends on the storage conditions, in addition to the rice cultivar type.

Conclusion

2-Acetyl-1-pyrroline (2-AP), aldehydes, heterocyclics, alcohols play important roles in rice aroma quality. A variety of volatile compounds influence the rice flavor quality. The survey suggested that many people actually preferred less chemicals and more nutritional value in rice. In conclusion, the biochemical pathways involved in the development of aroma and flavor in rice are complex and multifaceted, influenced by various genetic, environmental, and post-harvest factors.

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