SHORT COMMUNICATION

DEVELOPMENT OF LOW AMYLOSE RICE (*Oryza sativa*. L) VARIETY AT 309 FOR RICE BASED CONFECTIONERY PRODUCTION IN SRI LANKA

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ABSTRACT

Rice and its products are the staple food for the majority of people in developing countries. Rice is basically consumed as entire grain or grain-based products, especially in Asian countries. Consumer interests are considerable with low amylose comprised products which stand fairly in crispy texture with brown rice-based foods but do not contain the high amount of calories. Assortment of the most appropriate rice variety for puffing ability is very much crucial and is primarily dependent upon its amylose content. This has a direct impact on grain enlargement. Rice variety Bg 98-2571 and international rice line IR 70422-66-5-2 were crossed at Rice Research Station, Ambalantota expecting the maturity duration of 90-99 days and high yield white pericarp elite rice variety At 309. All growth, yield and quality parameters of the newly improved rice line were examined with stranded varieties. Variations of brown rice, head grains, gelatinization temperature, amylose content and major pest and disease reactions of the rice variety (At 309, At 306, At 308 and At 405) were screened. The experiment was laid out in randomized complete block design (RCBD), with four replicate and four rice varieties during the 2020/21 *Maha*. Analysis of variance was performed using STAR for Windows version 2.0.1 (IRRI 2014) and means were separated using LSD. Rice variety At 309 was recorded as significantly (p-value 0.05) lower amylose (15.5 - Low) rice variety which is effective to enhance the confectionary product quality improvement by avoiding the unnecessary water absorbance and making the appropriate cocking qualities with good texture. At 405 (17.2 - Low) rice variety was shown low amylose content most similarly to At 309. However, At 405 was not resistant to major pests and diseases. Although, rice variety At 309 was shown resistant to major pests and diseases such as Blast, Bacterial Leaf Blight, Gall Midge and Brown Plant Hoppers it was variety At 309 could be considered as most promising variety for the rice based confectionary production in the Sri Lanka.

Keywords: Amylose, Gelatinization, Rice, Texture, Yield

INTRODUCTION

Rice and its products are the main staple food for the majority of developing nations in the world. Rice grains are mainly just boiled and consumed by the majority of people or may be processed into another form by texture changing as an extension, extrusion, flattening, puffing *etc*. giving changings to advance qualities to rice-based food or confectionaries (Bhattacharya, 2013). Puffed rice-based products are an enormously well for consumption which expanding whole grain product mainly in Asia. Growing consumers' interest is being pragmatic for healthy, comprising of low fat and amylose products which stand quite similar to the crispy texture of browned foods but it is not comprised of a higher amount of calories. Assortment of most appropriate rice variety for popping is significantly crucial and mainly reliant on its amylose content as it has a direct influence on the amount of volumetric grain enlargement. Quality standpoint, higher or considerably moderate expansion ability is measured as one of the major indicators for good quality rice-

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based products. Parallel to the expansion proportions, colour, mouth feel, low moisture, aftertaste palatability, and granularity are considered as the key indicators of the sensory preferences of the rice based food products which depend upon the amylose content of rice. Properties related to thermal qualities of starch are considerably important to product quality enhancement including the gelatinization temperature and degree of gelatinization of starch or carbohydrate, amylose and lipid-based complex one (melting point temperatures <100 °C) and starch or carbohydrate, amylose based complex two (melting point temperatures >100°C), and amylopectin melting point range was 45–60 °C. Low amylose in rice helps to produce the high-quality confectionary with good texture (Juliano, 1992). Comparatively high or intermediate amylose containing rice grains absorb a considerable amount of water and subsequently expand more with cooking (Juliano, 1992) which is similar to the quality of the rice based confectionaries. High water absorbance mainly affects rice-based confectionary product qualities. Low amylose was shown a positive correlation with the wax content enhancement which helps to improve the rice based food product qualities (Khatun *et al*. 2003). Quality characters such as rice grains with waxy and soft medium gel consistency, intermediate and low amylose content and intermediate gelatinization temperature are mainly preferred by the majority of consumers (Khatun *et al*. 2003). Under the local conditions, rice varietal development and screening were not evaluated to identify the low amylose and low gelatinization temperature for rice base confectionary productions. Rice varieties At 309 (a crossed between Bg 98-2571 and IR 70422-66-5-2), At 308, At 306 and At 405 were screened to identify low amylose content, low gelatinization temperature and high yielding rice variety for rice base confectionary production.

MATERIALS AND METHODS

Rice variety Bg 98 - 2571 and international line IR 70422-66-5-2 were crossed at Rice Research Station (RRS), Ambalantota targeting the maturity duration of 90 - 99 days high yield and low amylose white pericarp rice variety. The emasculation of the female parents was done by the hot water method and controlled pollination was practiced. Line IR 70422-66-5-2 was received from the International Rice Research Institute as potential rice for high yield. The F_1 generation was planted in the research field at a spacing of 40×15 cm^2 with one plant per hill and seeds were harvested at maturity for the F_2 generation. Generations were advanced from F_2 to F_4 as bulk populations in subsequent seasons. The size of each bulk population was maintained between 5,000 to 6,000 plants following the modified bulk method. At F_4 generation single plants were selected visually for maturity duration, grain type, plant type and high grain yields and it was planted in the field on the plant to progeny basis in subsequent generations. Each progeny was a three-row plot planted with the spacing of 15×20 cm^2 with 120 plants per progeny. Generations were advanced by selecting better performing progeny lines in subsequent seasons until adequate progeny uniformity was achieved. Thereafter primary yield trial, secondary yield trial, national coordinated rice varietal trial, varietal adaptability test, large scale varietal adaptability test, distinct uniformity test and soil nitrogen test (yield response of tested variety was checked under the five nitrogen levels (0, 50, 100, 150 and 200) comparatively to the department of agriculture recommendation) were done in the RRS, Ambalantota. During the experimental period, varietal screening was done for the major pest and diseases. All parameters of the newly improved rice line At 05-1382 (At 309) were checked with all possible stranded check verities. The experiment was laid out in randomized complete block design (RCBD), with four replicate and four rice varieties during the 2020/21 *Maha* to compare the quality, yield and pest and disease reaction (Blast, Bacterial Leaf Blight, Gall Midge and Brown Plant Hoppers) of At 309, At 306, At 308 and At 405. During the experimental period amylose content, gelatinization temperature, brown rice content, head grain content and grain yield were determined. The comparison of each parameter of At 309 was done with, At 306, At 308 and At 405.

Analysis of variance was performed using STAR for Windows version 2.0.1(IRRI 2014) and means were separated using Least Significant Difference.

RESULTS AND DISCUSSION

Variations of brown rice percentage, head grains percentage, gelatinization temperature, amylose content, average grain yield and major pest and disease reaction of the newly improved rice variety At 05-1382 (At 309), At 306, At 308 and At 405 were presented in table 01. All rice varieties were contained the white pericarp and long medium grains. Significantly higher (0.05 p-value) amylose content (27.4) was reported in the rice variety At 308 while the lowest value was recorded in the rice variety At 309. At 309 and At 405 rice verities were recorded with the lowest amylose contents of 15.5 and 17.2 respectively which were categorized as lower amylose based on IRRI classification. Generally lower amylose composition is very much important to maintain the texture and quality of the product. Starch accumulation in the rice grain mainly depends on the temperature during the ripening period of the rice crop. Also, the amylose content of rice grains varies within the same cultivar depending on the cultivated area and season (Aboubacar *et al*. 2006) which influences consumer preference. Amylose content is the significant determinant factor of the cooking ability, beating ability, nutritional value and consumption qualities of rice (Gonzalez *et al*. 2004; Wickramasinghe and Noda, 2008) and it is correlated with textural characteristics.

Comparatively the rice grains which include a high amount of amylose can absorb a considerable amount of water and subsequently expand more with cooking (Juliano, 1992) which considerably influences rice-based confectionaries. Aberration and changing of the original shape of food products are caused to reduce consumer preference. Therefore, low amylose based rice verities are important to enhance the superiority of rice-based food products where newly improved At 405 and At 309 varieties can be nominated targeting rice-based food products. Rice can be mainly characterized according to the average amylose content as following waxy rice (0 to 5 %), very low amylose comprised rice (5 to 12 %), low amylose comprised rice (12 to 20 %), intermediate amylose comprised rice (20 to 25 %) and high amylose comprised rice (25 to 33 %) (Juliano, 1971; 1992 and Abeysekera *et al*. 2008). Rice grains with waxy and soft medium gel consistency, low and intermediate amylose content and intermediate gelatinization temperature are highly preferred by the majority of the consumers (Khatun *et al*. 2003). Similarly, low gelatinization temperature also increases the rice-based confectionary qualities. Gelatinization temperature (high gelatinization temperature (74.5 - 80 °C), intermediate gelatinization temperature (70- 74 °C) and low gelatinization temperature (< 70 °C) of rice which measured by the alkaline spreading value) is also inclined by the environmental temperature during grains development and ripening. Ambient temperature during the grain ripening will increase the gelatinization temperature (Faruq *et al*. 2004) which has reported a positive correlation with the amylose level of rice (Rebeira *et al*. 2014). Low amylose rice varieties such as At 309 and At 405 have a high possibility to gelatinize rapidly compared to the high amylose rice such as At 306 At 308. The low amylose content of the rice variety may be caused a reduction in the average cooking time compared to the high amylose rice (Hettiarachchi *et al*. 2016). Low amylose and gelatinization temperature directly affecting to consumers' preferable qualities of the rice-based confectionaries.

Significantly higher average grain yield was recorded in the rice variety At 309 (6.70 t/ha) and At 308 (7.07 t/ha). The lower yield was recorded in At 306 (4.73 t/ha) and At 405 (4.70 t/ha). Significantly higher brown rice percentages were recorded in At 309 (78.6 %), At 306 (78.6 %) and At 308 (79.9 %) rice varieties compared to the At 405 (76.8 %) similarly significantly higher head grains percentages were recorded in At 309 (71.4 %) and At 308 (74.3 %) rice varieties compared to the At 306 (66.3 %) and At 405 (68.3 %). Among the screened rice varieties At 405, At

Table 1: Variation of Amylose content, grain quality characters, yield and major pest and disease reaction of each variety

Variety	Amylose content (%)		Pest and disease resistance				Brown rice (%)	Head grains (%)	Gelatinization Temperature (GT)	Average grain yield (t/ha)	Pericarp colour
	Value	IRS	BL	BLB	GM	BPH					
At 309	15.5^{d}	L	MR	MR	MR	MR	78.6^{b}	71.4^{ab}	L	6.70^{b}	White
At 306	24.8^{b}	I	MR	MR	MR	MS	78.6^{b}	66.3^{c}	H/I	4.73^{c}	White
At 308	27.4^{a}	H	R	MS	MR	MS	79.9^{a}	74.3^{a}	H/I	7.07^{a}	White
At 405	17.2^{c}	L	S	MR	MR	MR	76.8^{c}	68.3^{b}	L	4.70^{c}	White

Note: Mean values with the same letter are not significantly different in each column ($\alpha = 0.05$)
IRS – Assigned value for amylose level of rice according to the IRRI standards
BL – Blast, BLB – Bacterial Leaf Blight, GB – Gall Midge, BPH – Brown Plant Hoppers
MR – Moderate Resistant, MS – Moderate Susceptible, R – Resistant, S – Susceptible
Determination of the gelatinization temperature and categorization were done according to the IRRI standards
(L - Low, H - High, H/I - High and Intermediate)

308 and At 306 were susceptible to some pests and diseases (Blast, Bacterial Leaf Blight, Gall Midge and Brown Plant Hoppers) according to the table 1, however rice variety At 309 was prone the pest and disease resistant ability comparing to all other verities.

CONCLUSION

Rice variety At 309 was recorded as having significantly lowest amylose content which is important to improve the confectionary product qualities. At 405 rice variety had low amylose content which is not resistant to major pests and diseases including Blast, Bacterial Leaf Blight, Gall Midge and Brown Plant Hoppers. Importantly, At 309 variety reported resistance to major pests and diseases and thus At 309 could be used as the most promising variety for rice-based confectionery production in Sri Lanka.

AUTHOR CONTRIBUTION

KHCHK, MHUS and RFH conceptualized and design the study. KHCHK and NPM performed the experiment. KHCHK, RFH and MHUS analyzed and interpret the data. BDP, MHUS and DMW breed the rice variety At 309. KHCHK and MHUS contributed in drafting the manuscript and KHCHK critically revised the manuscript.

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