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Glycemic Index of Diverse Rice Genotypes and Rice Products Associated with Health and Diseases

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Abstract. Rice (*Oryza sativa* L.) is the primary source of carbohydrate for more than half of global population. The highest rice consumption is in Asia which more than 100 kg per capita. It has been reported that rice elicits a high glycemic index (GI) ranged from 54 to 121 which considers to the higher GI compared to other starchy foods. Rice consumption showed a positive correlation with diabetes incidences. Regular consumption of high-GI rice has been accelerating the development of type-II diabetes problem due to high blood glucose excursions and related to insulin resistance. The objective of this review is to identify rice genotypes and also the rice products for low GI which potentially provide information associated with good eating habits and prevent type-II diabetes and others related diseases. Information regarding GI value of rice and other rice products might help rice consumers to choose the right food to reduce the risk of health problems. Nowadays, it is difficult to find food products with nutritional label of GI value. Most of the food products, the GI value has not been defined yet. Determination of GI in food products will significantly support healthy eating habits.

Keywords: rice genotypes, rice products, glycemic index, diabetes, amylose

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1. Introduction

Rice (*Oryza sativa* L.) is daily diets as main source of carbohydrates and nutrients for more than half of world-wide population with global consumption reaching 456 million tons [1,2]. The highest rice consumption is in Asia which more than 100 kg per capita [1]. It has been reported that rice elicits a high glycemic index (GI) ranged from 54 to 121 which considers to the higher GI compared to other starchy foods [3,4,5,6,7,8,9]. GI of a food is determined as the raise in the blood sugar level after the food consumption compared with a standard food, usually white bread [10,11,12,13]. Polished white rice is more consume by the rice consumers compared to un-milled brown rice. These polished white rice contribute to higher GI than brown rice which associated with a quick spike in blood sugar of the rice consumers [14,15,16,17]. Among rice consumers, brown rice is not popular because of rancidity, poor palatability, and short of self-life [18,19]. Thus, overeating rice contributes to improve GI and potentially to have type-II diabetes.

Rice is classified as a high GI food that influenced by rice varieties, environmental factors, post-harvesting processing, and cooking procedures. Nutrient composition of rice consist of carbohydrates (80%), protein (8%), fiber (3%), and fat (3%). Starch composition, including amylose and amylopectin with linear and branched chain structure, respectively. These starch composition significantly influence the GI of rice [20,21]. High-amylose rice showed lower GI level than low-amylose rice varieties [5,22,23,24,25]. Amylose has more compact structure, leading to have more resistant from enzyme activity. Therefore, high amylose content showed a positive correlation with higher percentage of resistant starch, consequently result in a lower GI [12,26]. Prevention of type-II diabetes can be managed by consuming low GI rice [27]. However, very few countries which consume low GI rice with hard textured and high-amylose content, such as Indonesia, Sri Lanka, Myanmar, and India. The intermediate-amylose rice varieties are consumed in Latin America, Northern America, Middle East, and South Asia. Meanwhile, low-amylose rice with sticky and waxy texture is popular in China, Vietnam, Taiwan, Japan, Thailand, Cambodia, Australia, and Lao PDR. Most of the rice varieties belong to high GI [18,28]. Decreasing the GI of rice by using various approaches such as classical breeding, mutation and genetic engineering will significantly prevent type-II diabetes and related diseases.

During the digestion process, starch from the rice hydrolyze in the mouth by a-amylase enzyme and continues in the small intestine with involvement of other digestive enzymes, and converted into glucose. This glucose become the primary energy source in metabolic mechanisms. The extra calories from the starch are stored as fats or glycogen [18,29]. Therefore, excess rice consumption combine with sedentary lifestyle leads to serious health problems, including type-II diabetes, obesity, and cardiovascular [30,31,32,33]. Information regarding GI value of rice and other rice products might help rice consumers to choose the right food to reduce the risk of health problems. According to Brand-Miller et al. [34], there are three levels of GI for foods, including low GI foods (55 or less), medium GI foods (56 - 69), and high GI foods (70 or more).

Rice exhibited a wide variety of glycemic index (GI) which has been influenced by amylose content, physical size of rice grains, dietary fiber content, cooking methods, and post-harvest treatments [35,36]. The GI of freshly cooked rice is 64 to 93 [37,38]. A high amylose content in rice involves in less increased blood glucose compared to the higher amylopectin content. Whole grain rice significantly showed less GI than ground rice. A high dietary fiber in rice produces less blood glucose compared to the rice with low dietary fiber. Cooking process in rice resulting a high GI due to the gelatinization process. Additionally, milling process of rice also increase GI. Meanwhile, brown rice without milling process showed lower GI.

Nowadays, it is difficult to find food products with nutritional label of GI value. Most of the food products, the GI value has not been defined yet. Determination of GI in food products will significantly support healthy eating habits. The objective of this review is to identify rice genotypes and also the rice products for low GI which potentially provide information associated with good eating habits and prevent type-II diabetes and others related diseases.

2. Methods

2.1. Data Collection

Important information and data related to glycemic index of diverse rice genotypes and rice production associated with health and diseases were collected from published articles from 1987 until 2023 on Google Scholar and PubMed data bases.

2.2. Data Analysis

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All descriptive statistics and analysis of variance (ANOVA) calculations from the collected data were analyzed by using JMP Genomics®7 (SAS Institute, Inc.).

3. Results and Discussion

3.1. Rice Glycemic Index in Health and Disease

Since 1980, global type-II diabetes population has been increasing from 108 million in 1980 become 463 million in 2020, and has predicted it will be increased reaching 700 million in 2050 [39]. Type-II diabetes has become a major global health problem [27,40]. Rice consumption showed a positive correlation with diabetes incidences. China, India, Pakistan, Brazil, Indonesia, Japan, and Bangladesh which consume rice as a staple food have high diabetes incidences. Regular consumption of high-GI rice has been accelerating the development of type-II diabetes problem due to high blood glucose excursions and related to insulin resistance [16,41,42]. Thus, low-GI rice potentially decrease the incidence of type-II diabetes and other health problems, including cardiovascular, obesity, and hyperlipidemia [43,44]. Meta-analysis identified that white rice significantly increase the risk of type-II diabetes [45,46]. Diverse rice genotypes showed high variability for GI. However, specific rice varieties with low-GI have been consuming by type-II diabetes patients [27,47]. Low-GI brown rice has been suggested to substitute the white rice in order to prevent and decrease the developing type-II diabetes [15,48]. Consumption of brown rice is relative low compared to the white rice. Acceptability of brown rice for rice consumers is lower than white rice due to the texture, aroma, taste, longer cooking time, and shorter self-life [16,49].

3.2. Glycemic Index Determination in Rice

The GI of rice can be measured by using in vivo and in vitro methods. In vivo testing for GI of rice, blood glucose of rice consumers were measured with glucose drink as the reference food. Glucose drink has a GI of 100 [27,50]. The disadvantages of in vivo method are associated with management of human volunteers and low reproducibility of the results. Hence, the simple method to determine GI of food need to be developed. Recently, in vitro method which could mimic the in vivo conditions was in progress. This in vitro method is rapid, simple, reliable, and inexpensive [30,51,52]. During in vitro testing for GI of rice, the cooked rice was mixed with artificial saliva at pH 7.0 that contains α-amylase, after 20 second the pepsin enzyme was added to acidify the sample become pH 6.0, and then incubated for 30 minutes at 37^{o}C in a shaking water bath. Pancreatin and amyloglucosidase were added to the rice sample and incubate for 5 hours. Glucose concentration of the rice was determined by using automated electrochemical technique (YSI 2700 Select Bioanalyser, Yellow Springs, OH). GI of the rice was calculated based on the percentage of CHO which converted to glucose during incubation time [27,53]. In 2020, Fernandes et al. [12] proposed the new method for in vitro GI determination, called INFOGEST. Protocols in INFOGEST, including starch hydrolysis evaluation, determination of GI, and morphology study of starch granules. Based on the INFOGEST results, rate of the starch hydrolysis in rice was influenced by amylose/amylopectin content, and rice grain characteristics, such as particle size, cell wall intactness, and protein content.

3.3. Correlation of Rice Glycemic Index and Cooking Process

GI of rice showed significant correlation with the cooking conditions, such as cooking time, cooking method, and cooking liquid volume [16,53]. Cooking conditions which potentially lower the GI of rice are less time for boiling and steaming, parboiling process, cooling technique, and pregerminated rice. Meanwhile, cooking conditions that significantly increase the GI of rice including explosion puffing of rice, soaking process, milling rice, and grinding process. Steamed rice products have a high GI. However steaming process in rice produce the lowest GI compared to various cooking methods, such as microwaving, electric cooking, and conventional boiling. Puffing process increases the GI of rice because porous structure and gelatinization. Puffed white rice showed a GI of 74, and puffed rice cake generated a high GI of 128. Soaking process of rice in warm water prior to cooking in order to soften the grain texture and to elongate the rice grains allow to get better gelatinization and the starch granule expansion leading to a higher GI [54]. Rice flour, porridge, and broken rice showed high GI because of the increased gelatinization and digestibility. In contrast, parboiling process of rice might reduce the GI due to the formation of resistant starch. Storing the cooked rice at refrigerator temperature 4^{o}C led to a reduction in GI because of the crystallization process which increase the resistant starch. Pregerminated brown rice following soaking in warm water potentially reduce the GI of rice because of the production acylated steryl glucoside dysfunctional enzymes. Un-milled rice called brown rice contains high resistant starch and fiber which significantly reduce the GI. Therefore, it is important to standardize the cooking methods of rice to control the GI.

3.4. Impact of Environmental Conditions on Rice Glycemic Index

Environmental conditions, including light, air temperature, soil nutrients, water, and atmospheric carbon dioxide also influence the GI of rice which mainly mediated by the starch contents such as amylose and amylopectin [56,57]. Under the low intensity light (shading) environment, the starch content, starch synthase (SS), and granule-bound starch synthase (GBSS) enzyme activity reduced. In the low temperature (cold) condition, ratio of amylose and amylopectin significantly increase. Whereas, heat temperature conditions decreased short chain of amylopectin and increased long chain of amylopectin. Amylose content of rice tend to be increased in the soil with excess nutrients of zinc and potassium. However, in salinity condition, the amylose content significantly decreased. Flooding condition increased the amylose contents. Excess carbon dioxide up to 700 ppm also increased amylose contents. Managing the rice cultivation in the proper environmental conditions is needed to produce high-quality rice grains with low GI value.

3.5. Glycemic Index in Diverse Rice Genotypes

Diverse rice genotypes with more than 2,500 rice varieties displayed high variability in GI which have a range from 48−160. Most of the rice varieties have a high GI (Table 1). In the market only can find few rice varieties with low GI and higher price. The GI level of rice is depend on the variety and influenced by amylose and amylopectin content. Three levels of GI for foods, including low GI foods (55 or less), medium GI foods (56 - 69), and high GI foods (70 or more). The primary grain component that affects GI is amylose content. Based on the ratio of amylose and amylopectin content, rice can be classified as high amylose (25−33%), medium amylose (20−25%), low amylose (12−20%), very low amylose (5−12%), and waxy (0−2%) rice [58,59,60,61]. Amylose content also influences the texture of cooked rice and showed positive correlation with water absorption during cooking [16,62]. A high GI rice tends to have soft-tender texture compared to hard-cooked rice. GI level of three varieties of rice, including japonica, javanica, and indica also showed differences. Indica rice showed low GI and high amylose (23−31%) with short and slender grains which commonly consumed in India and southern China. Meanwhile, japonica and javanica have high GI with low amylose content 0−25%. Japonica grains have short and round shape that is preferred in northern China, while javanica grains are long and thick (Kaur et al., 2016; Jukanti et al., 2020). Therefore, it allows rice consumers to choose specific rice varieties based on GI and amylose content.

Table 1. Glycemic index in cooked diverse rice genotypes

Rice Varieties	Estimated GI	References
Karaya	109.2	[63]
Thai Jasmine	100.0	[63]
Kinaures	96.9	[63]
Bagoean	92.3	[63]

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Koshihikari	80.0	[16]
Manumbaeay	87.3	[63]
Njavara	74.8	[64]
IR 64	73.2	[64]
Jyothi	73.1	[64]
Abhishek	70.4	[30]
Luna Barial	70.2	[63]
Heera	69.3	[30]
Kutsiyam	68.5	[63]
Milagrosa	68.0	[30]
Maudamani	67.9	[30]
NE-1	67.9	[30]
CR Dhan 201	67.7	[30]
Pooja	67.6	[30]
Nalbora	67.4	[30]
CR Dhan 310	66.9	[30]
Naveen	66.4	[30]
Nua Kalajeera	66.3	[30]
Kalobhat	65.5	[30]
Luna Sankhi	65.2	[30]
Sarala	63.9	[30]
Pyari	63.5	[30]
Ajay	63.5	[30]
Vandana	63.2	[30]
Tapaswini	62.4	[30]
Rajlaxmi	62.2	[30]
Riceberry	62.0	[65]
CR Dhan 907	61.4	[30]
Swarna	60.8	[30]
Mahsuri	60.1	[30]
Sinlek	58.0	[65]
Frontière	<55.0	[66]
Doongara	<55.0	[65]

Intensive selection in rice breeding program to develop low GI and high amylose by introduction suitable alleles regulating the low GI is important to prevent and reduce type-II diabetes cases. Waxy (gbssI) gene and starch synthase (SSIIIa) gene are the primary genes which related to GI in rice [27,67,68,69]. A recombinant inbred line (RIL) rice population was developed by crossing two rice varieties with high amylose content, IR5 and IR8 in order to identify the genes which associated to GI. Identification of the genetic basis of GI significantly improve the development of low GI rice. In 2017, LSU AgCenter has developed rice cultivar ‘Frontiere’ with low GI (<55), high protein (10.6%), long grain, semi-dwarf (36 inches), and Cypress genetic background by a mutagenesis approach [66]. Low GI PinK+4 rice was developed in Thailand with GI 48−79 combined with multiple tolerance to heat, submerge, and drought stress, and also resistance to several diseases, including brown planthopper, leaf blast, and bacterial leaf blight [65].

3.6. Glycemic Index of Rice Products

GI of rice products showed high variation influenced by the condiments, accompaniments, and also processing methods (Table 2). Acidic condiments, vegetables, dairy products (yogurt, cheese, and

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milk), pulses, emulsifiers, and viscous fiber eaten with rice impacts on GI reduction due to the macronutrient affect starch digestion [16,70,71]. Addition of other starches, such as potato, tapioca, and corn to the rice starch also decrease the GI of rice. Mixing rice with bean products, including fermented soybean, bean paste soup, grounded, and roasted soybean also reduce the GI of rice. Cooking methods that promote gelatinization and disrupt starch structure tend to increase the GI. Meanwhile, parboiling technique decrease the GI of rice. Recently, food industries has been developing low GI rice noodles, pastries, snacks, etc.

Table 2. Glycemic index in rice products

Rice Products	Estimated GI	References
Boiled White Rice		
BR 16	55	[72]
Long grain rice (Oxford, UK)	47	[73]
Gem long grain (Dainty Food Inc., Toronto, Canada)	86	[74]
Long grain, boiled 25 minutes	56	[75]
Long grain boiled 15 minutes	83	[76]
Long grain boiled 5 minutes	58	[76]
Italian rice	102	[77]
Pakistani rice	98	[78]
Canadian rice	80	[79]
Indian rice	68	[80]
ZF201, indica milled rice	63	[72]
Jiayu293, indica milled rice	79	[72]
Zhefu504, indica milled rice	99	[72]
Yunuo No. 1, indica milled rice	106	[72]
JIN3, japonica milled rice	78	[72]
Xiushui 11, japonica milled rice, low amylose	69	[72]
Shaonuo, indica milled rice, waxy	102	[72]
Hyou3027, hybrid milled rice	78	[72]
Zanuo, hybrid milled rice, waxy	100	[72]
Fenyouiangzan, hybrid milled rice	92	[72]
Xieyou46, hybrid milled rice	63	[72]
Iranian rice, boiled 10 minutes	55	[81]
Thai long grain, indica	60	[82]
Thai red rice	76	[73]
Koshihikari, japonica	80	[3]
Surti Kolam, India	77	[3]
Ponni rice, India	70	[3]
Sona Masuri rice, India	72	[3]
Bg 406 unparboiled rice	7	[83]
Bg 358 unparboiled rice	67	[83]
Bg 352 unparboiled rice	67	[83]
Bg 300 unparboiled rice	61	[83]
Rathkaral unparboiled	60	[83]
LD 356 unparboiled rice	70	[83]
Heendikwel unparboiled	62	[83]
Wedaheenati unparboiled	57	[83]
Red rice, Sri Lanka	99	[84]
Boiled Brown Rice		
Tai Ken (Union Rice Company, Taipei, Taiwan)	82	[85]
Sunbrown Quick (Rice Growers Co-op, Australia)	114	[37]

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Pelde brown (Rice Growers Co-op, Australia)	109	[37]
Doongara brown (Rice Growers Co-op, Australia)	94	[37]
Calrose brown (Rice Growers Co-op, Australia)	124	[37]
Brown rice, South India	50	[86]
Brown rice, USA	50	[87]
Brown rice, Canada	66	[79]
Boiled Basmati Rice		
Basmati with wild rice, North America	63	[73]
White and brown basmati rice	59	[73]
Brown basmati rice	75	[73]
White basmati (Mahatma brand, Sydney, Australia)	83	[88]
Parboiled Rice		
Bg 356 parboiled rice, Sri Lanka	64	[83]
Bg 358 parboiled rice, Sri Lanka	62	[83]
Bg 352 parboiled rice, Sri Lanka	60	[83]
Bg 406 parboiled rice, Sri Lanka	71	[83]
Hassawi rice, Al-Hassa, Saudi Arabia	59	[89]
Long-grain white parboiled (Uncle Ben's; Belgium)	54	[89]
Long grain, boiled 15 minutes, Canada	67	[76]
Long grain, boiled 5 minutes, Canada	54	[76]
Long grain, boiled 12 minutes, Denmark	60	[90]
Long grain, boiled 10 minutes, USA	61	[91]
Glutinous Rice		
Glutinous rice, Japan	105	[14]
Glutinous rice, Thailand	92	[73]
Glutinous rice, Thailand	94	[92]
Rice Noodles		
Pho (made from Thai long grain rice & tapioca starch)	62	[82]
Kway teow (made from Thai long rice & potato starch)	60	[82]
Instant rice vermicelli (Thai long grain rice, tapioca & potato starch)	59	[82]
Rice noodles, boiled, Australia	40	[92]
Rice noodles, dried, boiled (Thai World, Bangkok, Thailand)	61	[92]
Jiangxi rice vermicelli, cooked 8 minutes (Oxford, UK)	40	[73]
Guilin rice vermicelli, cooked 8 minutes (Oxford, UK)	37	[73]
Bihon, Philippines	49	[93]
Vermicelli, 99% long grain rice + 1% calcium	50	[82]
Vermicelli, 100% long grain rice	55	[82]
Taiwan vermicelli (rice, maize starch), Hongkong	68	[94]
Jianxi rice vermicelli (rice, water), Hongkong	55	[94]
Rice vermicelli, Kongmoon, China	83	[8]
Specialty Rice		
Instant Doongara, cooked 5 minutes (Rice Growers Co-op, Australia)	132	[88]
Instant rice, cooked 6 minutes (Rice Brand, Australia)	87	[6]
Instant rice, boiled 1 minutes (Canada)	65	[76]
Broken rice	86	[92]
Easy-cook long grain rice	47	[73]
Easy-cook basmati rice	80	[73]
Saskatchewan wild rice, Canada	57	[8]
Mexican Fast and Fancy (Uncle Ben's; Effem Foods Ltd, Canada)	58	[8]
Long grain and Wild (Uncle Ben's; Effem Foods Ltd, Canada)	54	[8]
Garden Style (Uncle Ben's; Effem Foods Ltd, Canada)	55	[8]
Cajun Style (Uncle Ben's; Effem Foods Ltd, Canada)	51	[8]
Other Rice Products		
Puffed rice cakes, Doongara rice (Rice Growers Co-op, Australia)	85	[88]

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Puffed rice cakes, Calrose rice (Rice Growers Co-op, Australia)	128	[88]
Puffed rice cakes, white (Rice Growers Co-op, Australia)	117	[88]
Rice bubbles (Puffed rice) (Kellogg's Australia)	95	[6]
Chinese Rice Food		
Rice with stir-fried vegetables and chicken	73	[16]
Plain steamed vermicelli roll	90	[16]
Steamed glutinous rice roll	89	[16]
Sticky rice wrapped in lotus leaf	83	[16]
Fried rice in Yangzhou-style	80	[16]
Salted meat rice dumpling	69	[16]
Glutinous rice ball	61	[16]
Fried rice noodles with sliced beef	66	[16]
Fried rice vermicelli in Singapore-style	54	[16]
Japanese Rice Food		
Glutinous rice cake (mochi)	101	[16]
Rice with soybean paste soup (miso shiru)	74	[16]
White rice and fermented soybean (natto)	68	[16]
White rice and roasted, ground soybean (beihan, kinako)	68	[16]
White rice low-amylose content and pickled food	75	[16]
White rice low-amylose content with raw egg, soy sauce	114	[16]
White rice low-amylose content rolled in toasted algae	94	[16]
White rice low-amylose content and dried fish strip	115	[16]
White rice low-amylose content and salted plum (umeboshi)	98	[16]
White rice low-amylose content with curry and cheese	67	[16]
Curry rice low-amylose content	82	[16]
Butter rice low-amylose content	96	[16]
White rice low-amylose content with milk	59	[16]
Sushi, rice low-amylose content, roasted sea algae	55	[16]
Indian and Sri Lankan Rice Food		
Red rice with lentil curry	60	[16]
Red rice with lentil curry, boiled egg, salad, coconut gravy	61	[16]
Parboiled rice with green leaf curry and gravy	55	[16]
Parboiled rice with soya meat gravy	56	[16]
Parboiled rice with green leaf curry (*Amaranthus*)	48	[16]
Rice, boiled with bottle gourd and tomato curry	69	[16]
Rice with lentil and cauliflower curry	60	[16]
Malaysian Rice Food		
Fried beehoon	99	[16]
Nasi lemak	66	[16]
Fried rice	59	[16]
Chilean Rice Food		
Lentil-rice meal	49	[16]

4. Conclusion

Identification and development of rice genotypes with low GI is important to prevent and reduce type-II diabetes cases. Rice grains with high- amylose content are potentially useful for low-GI diets. High-throughput phenotyping and cost-effective technique to select molecular markers associated with low-GI in diverse rice genotypes can accelerate identification and development low-GI rice. External process, such as cooking and other processing methods which can manipulate the properties of rice also significantly reduce the GI. It is important to standardize the cooking methods of rice to control the GI. The information presented in this review paper may be useful for selecting low-GI foods.

References

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ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v5i1/15287

[1] IRRI. Rice basics. 2010. Available from http://irri.org/about-rice/rice-facts/ rice-basics. Accessed 12 April, 2023.
[2] Meng F., Wei Y., et al. Iron content and bioavailability in rice. *J. Trace Elem. Med. Bio.*, 2005;18(4):333–338.
[3] Shobana S., Kokila A., Lakshmipriya N., Subhashini S. et al. Glycaemic index of three Indian rice varieties. *International Journal of Food Sciences and Nutrition*, 2012;63(2):178–183.
[4] Jaisut D., Prachayawarakorn S., Varanyanond W., Tungtrakul P., Soponronnarit S. Accelerated aging of jasmine brown rice by hightemperature fluidization technique. *Food Research International*, 2009;42:674–681.
[5] Hu P., Zhao H., Duan Z., Linlin Z., Wu, D. Starch digestibility and the estimated glycemic score of different types of rice differing in amylose contents. *Journal of Cereal Science*, 2004;40:231–237.
[6] Brand J. C., Nicholson P. L., et al. Food processing and the glycemic index. *Am. J. Clin. Nutr.*, 1985;42(6):1192–1196.
[7] Jenkins D. J. A., Wolever T. M. S., Jenkins A. L., Josse R. G., Wong, G. S. The glycemic response to carbohydrate foods. *Lancet*, 1984;18:388–391.
[8] Jenkins D. J., Wolever T. M., Taylor R. H., Barker H. et al. Glycemic index of foods: a physiological basis for carbohydrate exchange. *The American Journal of Clinical Nutrition*, 1981;34(3):362–366.
[9] Dwiningsih Y. Molecular Genetic Analysis of Drought Resistance and Productivity Traits of Rice Genotypes; University of Arkansas: Fayetteville, AR, USA. 2020.
[10] Jenkins D.J.A., Kendall C.W.C., Augustin L.S.A., Franceschi S., Hamidi M., Marchie A., Jenkins A.L., Axelsen M. Glycemic index: overview of implications in health and disease. *Am J Clin Nutr.*, 2002;76(1):266S–273S. Doi:10.1093/ajcn/76/1.266S
[11] Ludwig D.S. The glycemic index. *JAMA*, 2002;287(18):2414. Doi:10.1001/jama.287.18.2414
[12] Fernandes J., Madalena D., Pinheiro A., Vicente A. Rice in vitro digestion: application of INFOGEST harmonized protocol for glycemic index determination and starch morphological study. *J Food Sci Technol.*, 2020;57(4):1393–1404. Doi:10.1007/s13197-019-04174-x
[13] Dwiningsih Y. Alkahtani J. Genetics, Biochemistry and Biophysical Analysis of Anthocyanin in Rice (Oryza sativa L.). *Advance Sustainable Science, Engineering and Technology (ASSET)*, 2022;4(1). Doi:10.26877/asset.v4i1.11659
[14] Sugiyama M., Tang A.C., Wakaki Y., Koyama W. Glycemic index of single and mixed meal foods among common Japanese foods with white rice as a reference food. *European Journal of Clinical Nutrition*, 2003;57:743–752
[15] Sun Q., Spiegelman D., et al. White rice, brown rice, and risk of type 2 diabetes in US men and women. *Arch. Intern. Med.*, 2010;170(11):961–969.
[16] Kaur B., Viren R., Jeyakumar H. The Glycemic Index of Rice and Rice Products: A Review, and Table of GI Values, *Critical Reviews in Food Science and Nutrition*, 2016;56:2, 215-236. Doi: 10.1080/10408398.2012.717976
[17] Dwiningsih Y., Kumar A., Thomas J., Ruiz C., Alkahtani J., Al-hashimi A., Pereira A. Identification of Genomic Regions Controlling Chalkiness and Grain Characteristics in a Recombinant Inbred Line Rice Population Based on High-Throughput SNP Markers. *Genes*, 2021;12(1690). Doi:10.3390/genes12111690
[18] Jukanti A., Pautong P., Liu Q., Sreenivasulu N. Low glycemic index rice-a desired trait in starchy staples. *Trends in Food Science & Technology*, 2020:132–149. Doi:10.1016/j.tifs.2020.10.006
[19] Dwiningsih Y., Kumar A., Thomas J., Gupta C., Ruiz, C., Baisakh N., Pereira A. QTLs analysis and identification of candidate genes for flag leaf characteristics related to grain yield in US RIL rice population under drought conditions. American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA) International Annual Meeting, Salt Lake City, UT. 2021.

Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 5, No.1, April 2023, pp. 0230112-01 ~ 0230112-14
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v5i1/15287

[20] Sivakamasundari S.K., S. Priyanga, J. A. Moses, C. Anandharamakrishnan. Impact of processing techniques on the glycemic index of rice. *Critical Reviews in Food Science and Nutrition*, 2022;62(12): 3323-3344. Doi: 10.1080/10408398.2020.1865259
[21] Dwiningsih Y., Rahmaningsih M., Alkahtani J. Development of single nucleotide polymorphism (SNP) markers in tropical crops. *Advance Sustainable Science, Engineering and Technology (ASSET)*, 2020;2(2).
[22] Srikaeo K. Sangkhiaw J. Effect of amylose and resistant starch on glycemic index of rice noodles. *Food Science and Technology*, 2014;59:1129–1135. Doi:10.1016/j.lwt.2014.06.012
[23] Denardin C.C., Boufleur N., Reckziegel P., da Silva L.P., Walter, M. Amylose content in rice (*Oryza sativa*) affects performance, glycemic and lipid metabolism in rats. *Ciencia Rural*, 2012;42:381–387.
[24] Denardin C.C., Walter M., da Silva L.P., Souto G.D., Fagundes C.A.A. Effect of amylose content of rice varieties on glycemic metabolism and biological responses in rats. *Food Chemistry*, 2007;105:1474–1479.
[25] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira A. Molecular genetic analysis of drought resistance and productivity in US rice cultivars. Plant and Animal Genome XXVII Conference (January 12-16, 2019). 2019.
[26] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Ruiz C., Yingling S., Crowley E., Pereira, A. Molecular genetic analysis of drought resistance and productivity mechanisms in rice. Plant and Animal Genome XXVIII Conference, January 11-15, 2020.
[27] Fitzgerald M.A., Rahman S., Resurreccion A.P., Concepcion J., Daygon V.D., Dipti S.S., Kabir K.S., Klingner B., Morell M.K., Bird A.R. Identification of a major genetic determinant of glycaemic index in rice. *Rice*, 2011;4:66–74. Doi: 10.1007/s12284-011-9073-z
[28] Dwiningsih Y., Kumar A., Thomas J., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Quantitative trait loci and candidate gene identification for chlorophyll content in RIL rice population under drought conditions. *Indonesian Journal of Natural Pigments*, 2021;3(2):54–64. Doi:10.33479/ijnp.2021.03.2.54
[29] Ge X., Khan Z.I., Chen F., Akhtar M., Ahmad K., Ejaz A., Ashraf M.A., Nadeem M., Akhtar S., Alkahtani J., Dwiningsih Y., Elshikh, M.S. A study on the contamination assessment, health risk and mobility of two heavy metals in the soil-plants-ruminants system of a typical agricultural region in the semi-arid environment. *Environmental Science and Pollution Research*, 2022;29,14584–14594. Doi:10.1007/s11356-021-16756-4
[30] Kumar A., Sahoo U., Baisakha B., Okpani O., Ngangkham U., Parameswaran C., Basak N., Kumar G., Sharma S.G. Resistant starch could be dicisive in determining the glycemic index of rice cultivars. *Journal of Cereal Science*, 2018;79:348–353. Doi: 10.1016/j.jcs.2017.11.013
[31] Choi Y., Giovannucci E., Lee J.E. Glycaemic index and glycaemic load in relation to risk of diabetes-related cancers: a metaanalysis. *Br. J. Nutr*., 2012;108(11):1934–1947.
[32] Hu J., La Vecchia C., Augustin L.S., Negri E., de Groh M., Morrison H. Glycemic index, glycemic load and cancer risk. *Ann. Oncol*., 2013;24:245–251.
[33] Maqsood A., Khan Z.I., Ahmad K., Akhtar S., Ashfaq A., Malik I.S., Sultana R., Nadeem M., Alkahtani J., Dwiningsih Y., Elshikh, M. Quantitative evaluation of zinc metal in meadows and ruminants for health assessment: implications for humans. *Environmental Science and Pollution Research*, 2022; 29(15)21634–21641. Doi:10.1007/s11356-021-17264-1
[34] Brand-Miller J., Hayne S., Petocz P., Colagiuri S. Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. *Diabetes Care*, 2003;26:2261–2267.
[35] Chang U., Hong Y., Jung E., Suh H. Rice and the Glycemic Index. Academic Press., 2014;ISBN 9780124017160. 357–363. Doi:10.1016/B978-0-12-401716-0.00027-1.
[36] Sitrarasi R., Nallal U.M., Razia M., Chung W.J., Shim J., Chandrasekaran M., Dwiningsih Y., Rasheed R.A., Alkahtani J., Elshikh M.S., Debnath O., Ravindran B. Inhibition of multi-drug resistant microbial pathogens using an ecofriendly root extract of Furcraea foetida silver nanoparticles. *Journal of King Saud University-Science*, 2022;34(2)101794. Doi:10.1016/j.jksus.2021.101794

Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 5, No.1, April 2023, pp. 0230112-01 ~ 0230112-14
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v5i1/15287

[37] Miller J. B., Pang E., et al. Rice: A high or low glycemic index food? Am. J. Clin. Nutr., 1992;56(6):1034–1036.
[38] Bashir S., Gulshan A.B., Iqbal J., Husain A., Alwahibi M.S., Alkahtani J., Dwiningsih Y., Bakhsh A., Ahmed N., Khan M.J., Ibrahim M., Diao Z-H. Comparative role of animal manure and vegetable waste induced compost for polluted soil restoration and maize growth. *Saudi Journal of Biological Sciences*, 2021;28(4)2534–2539. Doi:10.1016/j.sjbs.2021.01.057
[39] International Diabetes Federation. IDF Diabetes Atlas Ninth edition 2019. 2019;ISBN: 978-2-930229-87-4
[40] Ali M.H., Khan M.I., Bashir S., Azam M., Naveed M., Qadri R., Bashir S., Mehmood F., Shoukat M.A., Li Y., Alkahtani J., Elshikh M.S., Dwiningsih, Y. Biochar and Bacillus sp. MN54 Assisted Phytoremediation of Diesel and Plant Growth Promotion of Maize in Hydrocarbons Contaminated Soil. *Agronomy*, 2021;11, 9, 1795. Doi:10.3390/agronomy11091795
[41] Salmeron J., Manson J. E. et al. Dietary fiber, glycemic load, and risk of noninsulin-dependent diabetes mellitus in women. *JAMA-J. Am. Med. Assoc*. 1997;277(6):472–477.
[42] Adil M., Bashir S., Bashir S., Aslam Z., Ahmad N., Younas T., Asghar R.M.A., Alkahtani J., Dwiningsih Y., Elshikh M.S. Zinc oxide nanoparticles improved chlorophyll contents, physical parameters, and wheat yield under salt stress. *Front. Plant Sci*. 2022;13,932861. Doi:10.3389/fpls.2022.932861
[43] Augustin L.S., Franceschi S., Jenkins D.J.A., Kendall C.W.C., Vecchia, C.L. Glycaemic index in chronic disease: A review. *Eur. J. Clin. Nutr*., 2002;56:1049–1071.
[44] Alkahtani J., Elshikh M.S., Dwiningsih Y., Rathi M.A., Sathya R., Vijayaraghavan P. In-vitro antidepressant property of methanol extract of Bacopa monnieri. *Journal of King Saud University – Science*, 2022;34,102299. Doi:10.1016/j.jksus.2022.102299
[45] Hu E.A., Oand P.A., Malik V., Sun Q. White rice consumption and risk of type 2 diabetes: meta-analysis and systematic review. *BMJ*, 2012;344:1–9.
[46] Alshiekheid M.A., Dwiningsih Y., Sabour A.A., Alkahtani J. Phytochemical Composition and Antibacterial Activity of Zingiber cassumunar Roxb. against Agricultural and Foodborne Pathogens. *Preprint,* 2022. Doi:10.20944/preprints202208.0511.v1
[47] Dwiningsih Y., Alkahtani J. Phenotypic Variations, Environmental Effects and Genetic Basis Analysis of Grain Elemental Concentrations in Rice (Oryza sativa L.) for Improving Human Nutrition. *Preprints*, 2022; 2022090263. Doi:10.20944/preprints202209.0263.v1
[48] Dwiningsih Y., Alkahtani J. Rojolele: a Premium Aromatic Rice Variety in Indonesia. *Preprints*, 2022; 2022100373. Doi:10.20944/preprints202210.0373.v1
[49] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Gill N., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Identification of QTLs and Candidate Loci Associated with Drought-Related Traits of the K/Z RIL Rice Population. *Research Square*, 2022. Doi:10.21203/rs.3.rs-1609741/v1
[50] Dwiningsih Y., Al-Kahtani, J. Genome-Wide Association Study of Complex Traits in Maize Detects Genomic Regions and Genes for Increasing Grain Yield and Grain Quality. *Advance Sustainable Science Engineering and Technology*, 2022;4(2), 0220209. Doi:10.26877/asset.v4i2.12678
[51] Lone J., Shikari A., Sofi N., Ganie S., Sharma M., Sharma M., Kumar M., Saleem M.H., Almaary K.S., Elshikh M.S., Dwiningsih, Y. Screening technique based on seed and early seedling parameters for cold tolerance of selected F2-derived F3 rice genotypes under controlled conditions. *Sustainability*, 2022;14(14):8447. Doi:10.3390/su14148447
[52] Dwiningsih Y., Kumar A., Thomas J., Gupta C., Ruiz C., Alkahtani J., Baisakh N., Pereira, A. Identification and expression of abscisic acid-regulated genes in US RIL rice population under drought conditions. In *82nd Meeting of Southern Section of the American Society of Plant Biologists*. 2021.
[53] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira, A. Identification of QTLs associated with drought resistance traits at reproductive stage in K/Z RILs rice population. In *5th Annual Meeting of the Arkansas Bioinformatics Consortium AR-BIC*. 2020.

[54] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira, A. Molecular genetic analysis of drought resistance and productivity in K/Z RIL rice population. *Arkansas Bioinformatics Consortium*. 2019.
[55] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Crowley E., Ruiz C., Pereira, A. Drought stress response in US recombinant inbred line of rice population. In *National Science Foundation (NSF) 26th National Conference*. 2019;26(76)127.
[56] Patindol J.A., Siebenmorgen T.J., Wang, Y. Impact of environmental factors on rice starch structure: A review. *Starch/Sarke*, 2015; 67:2–54. Doi: 10.1002/star.201400174
[57] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Yingling S., Basu S., Pereira, A. Circadian expression patterns of the HYR gene. *Arkansas Bioinformatics Consortium*, *7*(11), 2018;34.
[58] Juliano B. O. Rice in human nutrition. *Food and Agriculture Organization of the United Nations, International Rice Research Institute*, *Rome*. 1993.
[59] Dwiningsih Y., Kumar A., Thomas J., Pereira, A. Identification drought-tolerance rice variety for reducing climatic impacts on rice production. In *Fulbright Enrichment Seminar Climate Change, Estes Park, Colorado, USA*. 2017.
[60] Rock, W. R. L. Artificial Intelligence (AI) in Arkansas (AR). 2020.
[61] Ismanto A., Hadibarata T., Widada S., Indrayanti E., Ismunarti D., Safinatunnajah N., Kusumastuti W., Dwiningsih Y., Alkahtani J. Groundwater contamination status in Malaysia: level of heavy metal, source, health impact, and remediation technologies. *Bioprocess and Biosystems Engineering*. 2022. Doi:10.1007/s00449-022-02826-5
[62] Dwiningsih Y., Alkahtani, J. Agronomics, Genomics, Breeding and Intensive Cultivation of Ciherang Rice Variety. *Preprints*, 2022. 2022110489. Doi: 10.20944/preprints202211.0489.v1
[63] Frei M., Siddhuraju P., Becker K. Studies on the in vitro starch digestibility and the glycemic index of six different indigenous rice cultivars from the Philippines. *Food Chemistry*, 2003;83:395–402. Doi:10.1016/S0308-8146(03)00101-8
[64] Deepa G., Singh V., Naidu K. A comparative study on starch digestibility, glycemic index and resistant starch of pigmented (‘Njavara’ and ‘Jyothi’) and a non-pigmented (‘IR 64’) rice varieties. *J Food Sci Technol.*, 2010; (Nov–Dec 2010) 47(6):644–649. Doi:10.1007/s13197-010-0106-1
[65] Vanavichit, A. The hard solution to develop low glycemic rice for diabetes. Open Access Government. www.openaccessgoverment.org. 2021.
[66] Wenefrida I., Utomo, H. LSU-bred higher-protein, low-glycemic rice variety gains traction. Rice Research Station, Crowley. Louisiana Agriculture. 2021.
[67] Dwiningsih Y., Alkahtani J. Potential of Pigmented Rice Variety Cempo Ireng in Rice Breeding Program for Improving Food Sustainability. *Preprints;* 2023, 2023020039. Doi: 10.20944/preprints202302.0039.v1
[68] Alshiekheid M.A., Dwiningsih Y., Alkahtani, J. Analysis of Morphological, Physiological, and Biochemical Traits of Salt Stress Tolerance in Asian Rice Cultivars at Different Stages. *Preprints*, 2023;2023030251. Doi:10.20944/preprints202303.0251.v1.
[69] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Gill N., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Morphological, Physiological, and Genomics Responses of Recombinant Inbred Lines Rice Population under Drought Stress Condition. 2023 Meeting of Southern Section of the American Society of Plant Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/
[70] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Alkahtani J., Pereira, A. Overexpression of the Transcription Factor *HYR* in Rice Improves Grain Yield and Grain Quality under Drought and High Temperature Stress Conditions. 2023 Meeting of Southern Section of the American Society of Plant Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/
[71] Alkahtani J., Ruiz C., Thomas J., Dwiningsih Y., Kumar A., Pereira A. Characterization of Arabidopsis Activation Tagged Genes maintaining Photosynthesis in Response to Salinity and Fluctuating Light conditions. 2023 Meeting of Southern Section of the American Society of Plant

Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 5, No.1, April 2023, pp. 0230112-01 ~ 0230112-14
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v5i1/15287

Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/
[72] Larsen H.N., Rasmussen O.W., Rasmussen P.H., Alstrup K.K., Biswas S.K., Tetens I., Thilsted S.H., Hermansen, K. Glycaemic index of parboiled rice depends on the severity of processing: Study in type 2 diabetic subjects. *Eur. J. Clin. Nutr*., 2000;54:380–385.
[73] Ranawana D.V., Henry C.J.K., et al. Glycaemic index of some commercially available rice and rice products in Great Britain. *Int. J. Food Sci. Nutr*., 2009;60(s4):99–110.
[74] Wolever T.M., Jenkins D.J., Josse R.G., et al. The glycemic index: similarity of values derived in insulin-dependent and non-insulin-dependent diabetic patients. *Journal of the American College of Nutrition*, 1987;6(4):295– 305.
[75] Liu S., Willett W.C., et al. A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. *Am. J. Clin. Nutr*., 2000; 71(6):1455–1461.
[76] Wolever T.M.S., Jenkins D.J.A. Effect of fiber and foods on carbohydrate metabolism. In: Handbook of Dietary Fiber in Human Nutrition. Spiller, G., Ed., CRC Press Inc., Boca Raton. 1986.
[77] Gatti E., Testolin G., Noe D., Brighenti F., Buzzetti G.P., Porrino M., Sirtori, C.R. Plasma glucose and insulin responses to carbohydrate food (rice) with different thermal processing. *Annals of Nutrition and Metabolism*. 1987;31(5):296–303.
[78] Rahman M., Malik M.A., et al. Glycaemic index of Pakistani staple foods in mixed meals for diabetics. *J. Pak Med. Assoc*., 1992;42(3):60–62.
[79] Jenkins D.J.A., Wolever T.M.S., Jenkins A.L., Lee R., et al. The glycaemic index of foods tested in diabetic patients: a new basis for carbohydrate exchange favouring the use of legumes. *Diabetologia*. 1983;24(4):257– 264.
[80] Dilawari J.B., Kamath P.S., et al. Reduction of postprandial plasma glucose by Bengal gram dal (Cicer arietinum) and rajmah (Phaseolus vulgaris). *Am. J. Clin. Nutr*., 1981;34(11):2450–2453.
[81] Parastouei K., Shahaboddin M.E., Motalebi M., Mirhashemi S.M., Faraji A.M., Seyyedi F. Glycemic index of Iranian rice. *Scientific Research and Essays*, 2011;6:5302–5307.
[82] Sato S., Fukumura K., et al. Glycemic index and glucose utilization of rice vermicelli in healthy subjects. *Biol. Pharm. Bull*., 2010;33(8):1385–1393.
[83] Pathiraje P., Madhujith W.M.T., et al. The effect of rice variety and parboiling on in vivo glycemic response. 2010.
[84] Hettiaratchi U.P.K., Ekanayake S., Welihinda J. Do different fractions of digestible carbohydrates in foods influence the glycaemic responses? *Journal of Food and Agriculture*, 2009;2(2):28–35.
[85] Lin M., Wu M.C., Lu S., Lin, J. Glycemic index, glycemic load and insulinemic index of Chinese starchy foods. World J. *Gastroentero*, 2010;39:4973–4979.
[86] Kurup P.G., Krishnamurthy S. Glycemic index of selected foodstuffs commonly used in south India. International journal for Vitamin and Nutrition Research. Internationale Zeitschrift fur Vitamin-und Ernahrungsforschung. *Journal International de Vitaminologie et de Nutrition*, 1991;62 (3):266–268.
[87] Potter J.G., Coffman K.P., Reid R.L., Krall J.M., Albrink, M.J. Effect of test meals of varying dietary fiber content on plasma insulin and glucose response. *The American Journal of Clinical Nutrition*, 1981;34(3):328–334.
[88] Holt S.H.A.; Brand-Miller J. Increased insulin responses to ingested foods are associated with lessened satiety. *Appetite*, 1995;24(1):43–54.
[89] Al-Mssallem M.Q., Hampton S.M., et al. A study of Hassawi rice (Oryza sativa L.) in terms of its carbohydrate hydrolysis (in vitro) and glycaemic and insulinaemic indices (in vivo). *Eur. J. Clin. Nutr*., 2011;65(5):627– 634.
[90] Rasmussen O., Gregersen S., Hermansen K. Influence of the amount of starch on the glycaemic index to rice in non-insulin-dependent diabetic subjects. *British Journal of Nutrition*, 1992;67(03):371–377.
[91] Krezowski P.A., Nuttall F.Q., Gannon M.C., Billington C.J., Parker S. Insulin and glucose responses to various starch-containing foods in type II diabetic subjects. *Diabetes Care*, 1987;10(2):205–212.
[92] Chan H.M.S., Brand-Miller J.C., Holt S.H.A., Wilson D., Rozman M., Petocz P. Original communication: The glycaemic index values of vietnamese foods. *Eur. J. Clin. Nutr*., 2001;55:1076–1083.

Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 5, No.1, April 2023, pp. 0230112-01 ~ 0230112-14
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v5i1/15287

[93] Trinidad T.P., Mallillin A.C., et al. Glycemic index of commonly consumed carbohydrate foods in the Philippines. *J. Funct. Foods*, 2010;2(4):271– 274.
[94] Lok K.Y., Chan R., Chan D., Li L., Leung G., Woo J., Lightowler H.J., Henry C.J.K. Glycaemic index and glycaemic load values of a selection of popular foods consumed in Hong Kong. *Brit. J. Nutr*., 2010;103 (04):556–560