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COMPARATIVE STUDIES OF SOME AGRONOMIC AND GRAIN QUALITY TRAITS FOR THREE NEW DEVELOPED RICE VARIETIES

Fatma A. Hussein[(1)]* and Soheir N. Abd El-Rahman[(2)]

[(1)] Rice Research Department, Field Crops Research Institute, Agricultural Research Center, Egypt.

[(2)] Crops Technology Research Department, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. soheirkenawy@yahoo.com

*Crossponding author: fatma_awed2008@yahoo.com

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ABSTRACT: This study was conducted at Rice Department farm, Sakha Agriculture Research Station during 2018 and 2019 seasons. Yield and yield components, grain quality, cooking quality, chemical composition with nutrition content were estimated in this study for two Egyptian varieties (Sakha 108 and Giza 182) and introduced Black Rice variety.

The results showed that, Sakha 108 variety had the best grain quality characters (hulling %, milling% and head rice %) with high performance of grain yield. Giza 182 as indica type gave the good performance in yield and yield attributes. Black rice as introduced one had high levels of protein, ash, oil and minerals (iron, calcium and zinc) as nutritional elements compared with the other two varieties in both seasons, while the fiber crud percentage reached to the maximum for Sakha 108 in brown grains while the total carbohydrate was high in milled grains of Sakha 108. On the other hand, Giza 182 variety milled grains recorded the lowest content of minerals except for Ca. For cooking quality characters, results indicated that milled grains of Giza 182 gave the highest value of water uptake and produced the greatest volume expansion. Sakha 108 and Giza 182 brown and milled grains had the same time for cooking, while Black Rice variety grains gave the highest value for cooking time.

Key words: Rice Varieties, Black Rice, High Yield, Grain Quality, Traits, Food processing.

INTRODUCTION

Rice is one of the most important crops on which the majority of the world's population feeds. Rice cultivation is spread in many regions around the world, such as East Asian countries i.e. China, Japan, Thailand and others, as well as in India and in some African countries such as Egypt and in some South American countries like Brazil. There are three important types of rice, the most famous and most cultivated of them are Japonica and Indica type, and each of them has its own distinctive characteristics, whether on the level of vegetative and yield characteristics or at the level of the quality of the grains and the different cooking qualities as well as the nutritional value of each of them.

Egypt has the largest acreage under rice growing countries of world that ranks first in productivity, to sustain its high production and productivity, a number of high yielding cultivars and hybrid have been developed and notified recently past, out of which many cultivars are now in seed production. Significant variation in physical and mechanical properties has been shown

among rice cultivars produced in different parts of the world with the influence of diverse genetic and environmental factors (Izawa 2008; Mir *et. al.,* 2013). Physical and mechanical properties play important role in deciding the rice processing operations, which directly affect the quality of rice at industrial scale and hence determine its consumer acceptability. Yang *et.al.*, (2014), reported that the long history of rice domestication, the indica and japonica rice varieties have clearly diverged in morphological characteristics, agronomic traits and physiological and biochemical features, as well as in yield, quality and stress resistance. However, the proteins and genes responsible for these differences and their roles for these two rice types remain poorly characterized. In addition, the tremendous amount of geographic overlap in adaptation between the two types makes it difficult to identify indica and japonica rice efficiently).

According to Mahajan and Kaur (2014), rice is consumed as a whole kernel of white rice obtained by milling (dehulling and polishing) rough rice. The degree of milling depends on purposes of milling required. Therefore, degree of milling is one of the key factors affecting several aspects of rice quality such as nutritional, chemical, physicochemical, cooking, and eating quality. Also, the degree of milling brought about variations in nutrient contents. Thomas *et.al.,*(2013) mention that the economic value of rice depends on its cooking and processing quality, which can be measured in terms of water uptake ratio, grain elongation during cooking, solids in cooking water and cooking time. Grain quality is a very wide area encompassing diverse characters that are directly or indirectly related to exhibit one quality type (Siddiqui *et.al*., 2007). It also has been reported that a diet containing Black rice extracts which had anthocyanin (31.3g/100 g) decreased cholesterol, LDL- cholesterol and concentration of triacylglycerol in plasma of rats (Yodmanee *et.al.,* 2011).

Therefore, in this study, the characteristics of the yield, the grain quality, and the different cooking characters were studied as well as chemical composition and some nutritional elements were measured for the three varieties, one of them was Japonica type Sakha 108, Indica type Giza 182 and Black Rice in order to be used in breeding programs to improve the grain quality, cooking characteristics and nutritional aspects of rice.

MATERIALS AND METHODS

This study was established in the experimental farm of the Rice Research Department, Agricultural Research Station, Sakha - Kafr El Sheikh - Egypt, during 2018 and 2019 seasons, where three varieties in Table 1 were used i.e. Sakha 108 (as japonica type), Giza 182 (as indica type) and Black Rice (as japonica type). Black Rice is introduced variety rich in important nutrients to the human body. The sowing was carried out on the first of May in both 2018 and 2019 successive seasons in Randomized Complete Blocks Design (RCBD) with three replications. Cultural practices were applied as recommended by Recommendations of Rice Research Department. Rice Training Center (RRTC, 2013). Thirty-day old seedlings of each genotype were transplanted into one seedling per hill in the experimental plots. Each plot was 10 m^2 with plant spacing 20 × 20 cm between rows and hills.

Measurements:

1- The agronomic characters:

Duration (days), plant height (cm), number of tillers / plant, number of panicle / plant, panicle length (cm), panicle weight (g), 1000 grain weight (g) and grain yield(t/ha).

Table 1: Parentage, type and origin of studied rice genotypes.

No	Genotype	Parentage	Type	Origin
1	Sakha108	Sakha 101/HR5824-B-3-2-3//Sakha101	Japonica	Egypt
2	Giza 182	Giza 181/IR39422-16-1-1-3//Giza181	Indica	Egypt
3	Black Rice	Jiegnou 9601 (Chinese Line)	Japonica	China

2- Some of grain quality characters:

Hulling %

Duplicate 150 grams of rough rice from each variety were used for hulling percentage determination. It was calculated according to Khush *et al*., (1979) as follows:

$$\text{Hulling } \% = \frac{\text{Brown rice weight (g)}}{\text{Total rough rice weight (g)}} \times 100$$

Milling:%

It was also determined on the basis of Ghosh *et.al.,* (1971) as follows:

$$\text{Milling } \% = \frac{\text{Total milled rice weight (g)}}{\text{Total rough rice weight (g)}} \times 100$$

Head rice %

The whole grains (head rice) were separated according to the broken size (less than 1/4th of grain length) with rice-sizing device and then weighted. Head rice percentage was determined as follows:

$$\text{Head rice \%} = \frac{\text{Weight of head rice (g)}}{\text{Rough rice weight (g)}} \times 100$$

Gelatinization temperature (GT)

Such alkali spreading and clearing of starchy endosperm represented the GT which was visually rated on 7– point numerical scale adopted by Little *et.al.,* (1958) scale spreading into class as follow; 1- Kernel not affected (very high), 2- Kernel swollen (high), 3- Kernel swollen, collar incomplete or narrow (high- intermediate), 4- Kernel swollen, collar complete and wide (intermediate), 5- Kernel split or segmented, collar complete and wide (intermediate), 6- Kernel dispersed, merging with collar (low), and 7- Kernel completely dispersed and intermingled (very low).

Kernel elongation %

The length of cooked grains was measured in millimeters. Average length of row and cooked grains was calculated. The proportionate change (PC) in L/W ratio was calculated according Sood *et.al.,* (1980) as follows: PC{(Lf/Wf) – (L0/W0)}/(L0/W0)

Where: Lf/Wf = length / width of the grain after cooking (mm)؛ L0/W0 = length /width of the grain before cooking (mm), respectively.

The following criterion was adapted for classifying varieties with respect to grain elongation :Degree of elongation into Proportionate Change (PC) as follows; very high (>1.00), high (0.70–1.00), medium (0.40–0.69), low (0.10–0.39), and poor (< 0.10).

Amylose content %

Amylose content % was determined according to the methods of Williams *et.al.,* (1958). Amylose content was determined by reference to a standard curve and expressed on a dry weight basis. Plot the absorbance values at 620 mμ. Against the concentration of anhydrous amylase (mg) and determine the conversion factor. The dilution factor of 20 for the sample was included in the conversion factor .

The following scale was used for classifying amylose content (AC); waxy rice (< 7%), non-waxy rice: very low amylose content (7–10%), low amylose content (10–20%), intermediate amylose content (20-25%), and high amylose content (> 25%).

Determination of chemical composition:

Moisture, ash, crude protein, crude fiber contents were determined according to the methods of Association of Official Agricultural Chemists (AOAC 2010). Total carbohydrates content was calculated by subtracting protein, ash, and crude fiber from total mass of 100 as reported by AOAC (2010).

Minerals content

Minerals content (Fe, Ca, Mg, Zn and K) were determined by using the flame photometer (Galien kamp, FGA 330, England) and Perkin Elmer Atomic Absorption Spectrophotometer. (Model 80, England) as described in AOAC (2010).

Determination of cooking quality:

Water uptake, volume expansion and cooking time of rice cultivars were determined following to procedures of Simpson *et.al.,* (1965).

Statistical analysis

The obtained data were subjected to analysis of variance according to Gomez and Gomez (1984). All statistical analysis was performed using analysis of variance technique by means of (COSTAT) computer software package. Least Significant differences test (LSD 0.05 and 0.01) was compare among the means of treatments.

RESULTS AND DISCUSSION

1- Agronomic and yield characters

Duration is considering an important character which affected on the other yield characters. In Table 2, Sakha 108 gave the longest days for duration, highest number of tillers and panicles / plant. Also it recorded the highest value in panicle weight. As well as it gave the highest fertility % with highest 1000 grain weight also, gave the highest grain yield t/ha in the two seasons. For Giza 182, recorded the average between the other two varieties in duration period, number of tillers and panicles/plant, panicle weigh and grain yield/ha in the two seasons. Also, it gave the highest value in plant height and panicle length. While Black Rice variety have the short duration and gave the lowest values in plant height, number of tillers and panicles, panicle weight, panicle length and grain yield/ha in the two seasons. These results are in harmony with those obtained by Hammoud *et.al.,* (2020), *Gewaily et.al*., (2019) and Anis *et.al.,* (2016).

Some grain quality characters:

Excellent quality characteristics are among the important criteria that are taken into consideration when starting to design hybridization and selection programs, so that we can obtain high-yield rice varieties with high grain quality to meet farmers' needs, as well as consumer requirements with high-quality rice grains and excellent cooking quality to suit the Egyptian taste for consumers.

Data in Table 3 showed that, Sakha 108 was the best variety in hulling %, milling %and head rice % in the two seasons, which gave the highest values for these characters followed by Black Rice which was higher in head rice %. These results are in harmony with those obtained by Hammoud *et al.,* (2020).

Table 2: Duration (days), plant height (cm), No., of tillers/plant, number of panicles/plant and Panicle weight (g), Panicle length (cm), Fertility (%), 1000 grain weight (g) and Grain (yield t/ha) of the three rice varieties during 2018, 2019 seasons.

Characters / Varieties	Duration (Day)		Plant height (cm)		No., of tillers/plant		No., of panicles /plant		Panicle weight (g)		Panicle length (cm)		Fertility (%)		1000 grain weight (g)		Grain yield (t/ha)	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sakha108	135.3	139.66	92.33	92.66	22.66	22.00	20.33	20.00	3.23	3.35	21.00	21.07	93.6	92.38	27.86	28.08	10.86	11.15
Giza 182	124.3	122.66	96.00	95.33	19.00	19.33	17.33	18.33	3.26	3.26	23.5	23.19	92.9	92.86	23.23	22.95	10.9	10.98
Black Rice	117.0	116.33	92.00	90.33	12.33	12.00	11.00	11.33	2.8	2.32	19.82	20.08	93.00	92.58	26.7	26.93	8.03	8.27
LSD 0.05	5.75	4.95	5.60	4.20	2.61	3.29	2.56	2.56	0.24	0.50	2.69	1.23	5.26	2.60	1.47	2.05	0.81	0.66
LSD 0.01	9.54	8.12	9.29	6.97	4.34	5.46	4.24	4.24	0.40	0.83	4.47	2.02	8.72	4.32	2.44	3.41	1.34	1.10

*, **Significant at 0.05 and 0.01 levels of probability, respectively.

Table 3: Hulling (%), Milling (%), Head Rice (%), Gelatinization temperature (GT), Elongation% and Amylose content (%) of three rice varieties during 2018 and 2019 seasons.

Characters / Varieties	Hulling (%)		Milling (%)		Head Rice (%)		Gelatinization temperature (GT)		Elongation (%)		Amylose content (%)	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sakha108	80.23	80.23	72.26	72.11	63.06	64.2	6.33	6.33	43.03	42.70	18.4	18.66
Giza 182	78.93	79.11	67.9	68.2	57.5	57.85	6.33	7.00	43.73	43.84	17.8	17.68
Black Rice	78.43	79.22	68.1	67.66	59.83	60.07	5.66	6.33	51.13	48.44	21.46	21.19
LSD 0.05	1.87	2.78	4.18	5.03	5.53	6.16	3.02	2.38	4.44	3.94	0.31	0.83
LSD 0.01	3.10	4.61	6.94	8.35	9.18	10.22	5.01	3.96	7.36	6.53	0.52	1.37

***, **Significant at 0.05 and 0.01 levels of probability, respectively**

Giza 182 gave the highest values of Gelatinization temperature (GT), with low amylose in the two seasons. Black rice variety gave the highest value in elongation % character with high amylose in the two seasons. For amylose content, Rachel *et.al.*, (2013) mentioned that amylose content % have significant role in all cooking and eating properties of a rice variety.

Chemical composition of rice grains

Chemical composition of studied varieties is shown in Table (4). The moisture content significantly varied among the rice grains that ranged between 12.35 to 14.00% in the first season and from 12.31 to 13.89% in the second season. Giza 182 brown grains gave the highest moisture content followed by Sakha 108 milled grains 14.00% and 13.89% and13.89%-13.80% in both seasons. The lowest moisture content was recorded with Black Rice cultivar in both seasons. These values were below than 14% (optimal %) for bag storage of grains (Juliano and Villarreal, 1993), low moisture content is known to enhance keeping quality of rice under storage.

Protein content in rice is one of the most important determinants, which influence the quality of grains (Singh *et. al.,* 2014). Protein content of the tested varieties ranged from 6.11 to 10.69%. The highest protein content was produced from Black Rice, followed by Giza 182 brown grains in both seasons. Sakha108 and Giza 182 milled grains followed by the other tested varieties which gave the same lowest values in the two seasons. The lowest protein content was estimated in Sakha 108 milled grains in the two seasons (Table 4). Protein is the second highest component after starch in rice kernel. Protein is available in varying amounts in rice, mostly ranging from 6.5% to 8.7% with some exceptions, where it varies from the main range (Mir *et.al. ,*2016). Black Rice has the highest amount of protein than other varieties (Murali and Kumar, 2020). Giza 182 had 6.79% protein (Gewaily, *et.al.,* 2019).

Ash residual is generally taken to be a measure of the mineral content of materials. High ash content in milled rice is an indication of a good quality of minerals (Dipti *et.al.,* 2003). In both seasons, Black Rice had the highest values of ash content followed by other varieties, while Giza 182 milled grains had the lowest values for ash content in both seasons.

Table 4: Chemical composition of the three rice varieties during 2018 and 2019 seasons on dry weight basis.

Characters / Varieties	Moisture%		Protein%		Ash%		Oil%		Fiber%		Carbohydrate%	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sakha108 milled grains	13.9	13.83	6.16	6.1	0.96	1.03	0.56	0.60	0.66	0.63	91.67	91.66
Sakha108 brown grains	13.66	13.43	9.96	9.9	1.46	1.5	1.56	1.6	1.5	1.46	85.6	86.56
Giza 182 milled grains	13.6	13.46	7.4	7.36	0.93	0.93	1.00	1.03	0.53	0.5	90.13	90.2
Giza 182 brown grains	14.0	13.9	10.4	10.43	1.33	1.33	1.56	1.63	0.63	0.63	86.13	86.03
Black Rice	12.4	12.3	10.63	10.7	1.83	1.86	1.76	1.73	0.6	0.6	85.2	85.1
LSD 0.05	0.20	0.45	0.09	0.21	0.17	0.12	0.18	0.18	0.10	0.12	0.27	0.30
LSD 0.01	0.30	0.65	0.13	0.30	0.25	0.18	0.27	0.27	0.14	0.18	0.39	0.44

*, **Significant at 0.05 and 0.01 levels of probability, respectively

Sakha 108 milled grains had the lowest fat content compared to brown grains and other varieties in both seasons (Table 4).

The fiber crude significantly varied among the rice cultivars that ranged between 0.52 to 1.48% in the first season and 0.49 to 1.46% in the second season. In both seasons, Sakha 108 brown grains had the highest values of fiber crude followed by other varieties. The lowest values of fiber crude were recorded with Giza 182 milled grains.

Data also showed that the rice varieties significantly differed in total carbohydrate percentage. Sakha 108 and Giza 182 milled grains gave the highest values of total carbohydrate percentage 85.17%- 91.67% and 85.12%- 91.16 %, in 2018 and 2019 season respectively. While brown grains for Sakha 108 followed by Giza 182 and Black Rice grains had the lowest values of total carbohydrate percentage (85.55%- 85.56%), (86.11%- 86.00%) and (85.17%- 85.12%) for 2018 and 2019 season respectively) (Table 4). Murali and Kumar (2020), investigated that black rice has low amount of carbohydrates. The results indicated that Sakha 107 had the highest value of total carbohydrate content in both seasons compared to Giza 182 and Giza 179 (Gewaily, *et.al.,* 2019).

Cooking quality of rice grains:

The water uptake ratio is an important parameter during cooking rice (Horigane *et.al.,* 2000). The rice cooking quality characteristics in milled and brown grains of tested varieties were evaluated included water uptake (ml H_2O/100g rice), volume expansion and cooking time (min.). Highly significant differences were observed for each of the previous characteristics among the tested varieties (Table 5). Data showed that Giza 182 milled grains variety gave the highest values for water uptake followed by brown grains and other varieties, while Sakha 108 brown grains gave the lowest values for water uptake in both seasons. The other variety under study came in between. The water absorption by rice during cooking is considered as an economic quality parameter, because it gives the estimate of the volume increase during cooking. The present results are agreeing with Gewaily, *et.al.,* (2019), they reported that Giza 182 was contained the highest values of the water uptake ratio compared with Giza 179 and Sakha 107 in both seasons. During cooking, rice grains absorb sufficient water and increase in volume through increase in length and width. Lengthwise increase without increase in girth is desirable characteristic in high-quality rice (Shinde *et.al.*, 2014).

Table 5: Cooking quality of three rice varieties during 2018, 2019 seasons.

Sample	Water uptake %		Volume Expansion %		Cooking time (min)	
	2018	2019	2018	2019	2018	2019
Sakha108 milled grains	249.4	248.2	242.8	242.1	15	15
Sakha 108 brown grains	194.1	193.3	233.0	232.3	30	30
Giza 182 milled grains	281.4	280.6	300.0	299.3	15	15
Giza 182 brown grains	221	220.6	243.6	243.0	30	30
Black Rice	216.4	219.9	250.0	249.4	35	35
LSD 0.05	3.12	3.64	4.28	5.31	NS	NS
LSD 0.01	4.54	5.30	6.23	7.73	NS	NS

***, **Significant at 0.05 and 0.01 levels of probability, respectively**

The cooking time is the time needed to make the opaque central portion of the rice grain disappears completely during cooking (Itagi, and Singh, 2015). Results in Table (5) indicated that the cooking time was high in Black rice followed by Sakha 108 and Giza 182 milled and brown grains in both seasons.

Minerals are essential chemical elements that play an important role in glucose homeostasis, the transmission of nerve impulses and enzyme cofactors in the body. Macro minerals are needed in large amounts, while trace minerals are needed in very small amounts. The minerals content of three rice varieties during 2018, 2019 seasons are presented in Table 6. Black Rice gave the highest Fe content in both seasons followed by Giza 182 brown grains, while Giza 182 milled grains recorded the lowest content of Fe. For Ca content, Sakha 108 recorded the lowest value in both seasons, while Black Rice had the highest value. Giza 182 milled grains gave the lowest value in Mg content in 2018and 2019 season.

Giza 182 milled grains contained the lowest Zn and K content in both seasons. Sakha 108 brown grains, Black rice gave the highest K content, respectively. On the other hand, the highest amount of Ca, Fe and Zn were observed in Black rice variety. These results confirmed that higher mineral contents can be found in black rice variety followed by Sakha 108 brown grains and Giza 182 brown grains than milled varieties. Similarly, Zhang *et.al.,* (2004) reported that a higher amount of minerals, such as iron, zinc, manganese, and phosphorus, were found in Black Rice.

Table 6: Minerals (ppm) of three rice varieties during 2018, 2019 seasons.

Sample	Fe		Ca		Mg		Zn		K	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sakha108 milled grains	5.43	5.5	491.5	501.4	536.1	532.76	14.8	15.0	473.4	481.06
Sakha108 brown grains	6.1	6.5	527.1	531.0	637.86	638.2	19.13	19.3	1749.43	1745.1
Giza 182 milled grains	3.93	3.7	522.5	518.0	168.66	171.1	12.1	13.00	231.06	233.13
Giza 182 brown grains	7.66	7.73	622.5	631.0	508.83	511.23	19.4	19.3	1260	1262
Black Rice	9.13	9.2	1033.76	1017.9	197.36	200.16	20.5	20.8	1450.26	1462.1
LSD 0.05	0.50	0.32	4.66	2.32	1.65	3.96	0.54	1.42	17.23	10.87
LSD 0.01	0.73	0.4	6.78	3.38	2.41	5.76	0.79	2.08	25.08	15.82

***, **Significant at 0.05 and 0.01 levels of probability, respectively**

Conclusion

Egyptian rice varieties contain many qualities desired traits and accepted by farmers and consumers, such as early and high yield, as well as quality characteristics such as high milling % and head rice with low amylose percentage preferred by consumers as showed in Sakha 108. Also in Black Rice, It was found that it contains a good percentage of some minerals important to the human body. Black rice, Sakha 108 and Giza 182 brown grains has several promising health benefits. They are rich source of Fe, Zn, Mg and K.

REFERENCES

AOAC (2010). Official Methods of Analysis of the Association of Official Analytical Chemists, 18th ed., (Ed. Horwitz, W.), Washington.

Dipti, S.S., M.N. Bari and K.A. Kabir (2003). Grain Quality Characteristics of some Beruin Rice Cultivars of Bangladesh. Pakistan Journal of Nutrition, 2(4):242-245.

Anis, G.B., Elmoghazy A. M. and Nahla S. Zidan (2016). Grain Quality and Nutritional Value of Some Egyptian and Exotic Rice (*Oryza sativa* L.) Varieties. Alex. J. Agric. Sci. Vol. 61, No. 2, pp. 105-113.

Gewaily, E.E., Amera T. Mohammed and W.T. Abd El-Rahem (2019). Effect of Different Irrigation Regimes on Productivity and Cooking Quality of Some Rice Varieties. World Journal of Agricultural Sciences 15 (5): 341-354.

Ghosh, A.K., B.B. Nanda, S. Govindaswamy and B.B. Nayak (1971). Influence of nitrogen on the physicochemical characteristics of rice grain. *Oryza*, *8*, 87-98.

Gomez, Kwanchai A. and Arturo A. Gomez (1984). Statistical Procedures for Agricultural Reserch Second Edition. "An International Rice Research Institute book." "A Wiley-

Interscience publication." Copyright by John Wiley & Sons, Inc.

Hammoud, S.A., M.I. Aboyessef, S.E. Sedeek, R.A. EL-Namaky, M.M. El-Malkey, A.B. EL-Abd, M.H. Ammar, A.A. AbdAllah, *et.al.,* (2020). Sakha108 Egyptian Rice Variety Japonica Type High Yielding and Resistant to Blast. J. of Plant Production, Mansoura Univ., 11 (11): 1153 – 1162.

Horigane, A.K., W.M. Engelaar, H.G. Toyoshima, H.Ono, H. Sakai, M.A. Okubo and T. Nagata (2000). Differences in hollow volumes in cooked rice grains with various amylose contents as determined by NMR micro-imaging. Journal of Food Science, 65: 408-412.

Itagi, H.N. and V. Singh (2015). Status in physical properties of colored rice varieties before and after inducing retrogradation. J. Food Sci. Technol., 52(12): 7747-7758.

Izawa, T. (2008). The process of rice domestication: a model based on recent data. Rice 1(2):127–134 .

Juliano, B.O. and C.P. Villarreal (1993). Grain Quality Evaluation of World Rice. P.148. International Rice Research Institute, Philippines.

Khush, G.S., C.M. Paule and N.M. Dela Cruz (1979). Rice grain quality evaluation and improvement at IRRI. Proc. The Workshop on " Chemical Aspects of Rice Grain Quality". IRRI, Los Banos, Philippines.

Little, R.R., G.B. Hilder and E.H. Dowson (1958). Differential effect of dilute alkali on 25 varieties of milled white rice. *Cereal Chem*, 35: 111-126.

Mahajan, S. and S. Kaur (2014). Quality analysis of Indian Basmati rice grains using top-hat transformation. Inter. J. Computer Applications, 94: 42- 47.

Mir S.A., S.J.D. Bosco and K.V. Sunooj (2013). Evaluation of physical properties of rice cultivars grown in the temperate region of India. Int. Food Res. J., 20(4):152–1527.

Mir S.A., S.J.D. Bosco, M.A. Shah, M.M. Mir and K.V. Sunooj (2016). Cultivar difference in quality characteristics, antioxidant properties and mineral composition of brown rice. J Food Measur Charact., 10(1): 177–184.

Murali, R.D. and N. Kumar (2020). Black Rice: A Novel Ingredient in Food Processing. J Nutr Food Sci 10:771. doi: 10.35248/2155- 9600.20.10.771.

Rachel, T., N. Wan, N. Wan and B. Rajeev (2013). Physiochemical properties, proximate composition, and cooking qualities of locally grown and imported rice varieties marketed in Penang, Malaysia. Inter. Food Res. J., 20(3): 1345-1351.

RRTC (2013). Rice Research and Training Center (National Rice Research Program): Final results of 2012- 2017 growing season. Sakha, Kafrelsheikh, Egypt.

Shinde, Y.H., A.Vijayadwhaja, A.B. Pandit and J.B. Joshi (2014). Kinetics of cooking of rice: a review. J. Food Eng., 123:113–129.

Siddiqui, S.U., T. Kumamaru and H. Satoh (2007). Pakistan rice genetic resources-I: grain morphological diversity and its distribution. Pak. J. Bot. 39: 841-848.

Simpson, J.E., C.R. Adair, G.O. Kohler, E.H. Dawson, H.J. Deobald, E.B. Kester, J.T. Hogan, O.M. Batcher and J.V. Halick (1965). Quality evaluation studies of foreign and domestic rices, pp. 186. U.S. Dept. Agric. Res. Serv. Tech. Bull. 1331.

Singh, N., K.K. Vashit, S.S. Mahal and N. Sharma (2014). Quality characteristics of rice grains as influenced by varying irrigation regimes in furrow and bed transplanted rice (*Oryza sativa* L.). International Journal of Agricultural Sciences, 10(1): 216-220.

Sood, B.C. and E.A. Siddiq (1980). Studies in component quality attributes of Basmati Rice, (Oryza sativa L.). *Z.Pflanzenzuchtg*, 84: 294 – 301.

Thomas, R., W. A.Wan-Nadiah and R. Bhat (2013). Physiochemical properties, proximate composition, and cooking qualities of locally grown and imported rice varieties marketed in Penang, Malaysia. IFRJ, 20: 1345-1351.

Williams, V.R., W.T. Wu, H.Y. Tsai and H.G. Bates (1958). Varietal differences in amylose content of rice starch. *J. Agr. Food Chem*, 6: 47-48.

Yanhua Yang, Keming Zhu, Hengchuan Xia, Liang Chen and Keping Chen (2014). Comparative proteomic analysis of indica and japonica rice varieties, Genetics and Molecular Biology Online Ahead of Print Copyright © 2014, Sociedade Brasileira de Genética. Printed in Brazil www.sbg.org.br).

Yodmanee, S.,T.T. Karrila and P. Pakdeechanuan (2011). Physical, chemical and antioxidant properties of pigmented rice. Inter Food Res. J. 18, 901-906.

Zhang, M.W., B.J. Guoand Z.M. Peng (2004). Genetic effects on Fe, Zn, Mn and P contents in Indica black pericarp rice and their genetic correlations with grain characteristics. Euphytica, 135: 315–323.

مقارنه بعض الصفات المحصوليه وصفات جوده الحبوب لثلاث اصناف من الارز المحسنه

فاطمه عوض حسين[١] ، سهير نظمى عبد الرحمن[٢]

[١] قسم بحوث الارز – معهد بحوث المحاصيل الحقليه– مركز البحوث الزراعيه –مصر

[٢] قسم بحوث تكنولوجيا المحاصيل– معهد بحوث تكنولوجيا الاغذيه– مركز البحوث الزراعيه–الجيزه – مصر

الملخص العربى

أقيمت هذه الدراسه فى المزرعة البحثية لقسم بحوث الارز محطة البحوث الزراعية بسخا خلال موسمى الزراعه ٢٠١٨ و ٢٠١٩. بهدف دراسة الصفات الخاصة بالمحصول ومكوناته وبعض صفات الجوده للاصناف التاليه : سخا ١٠٨ وهو صنف محلى طراز يابانى و جيزة ١٨٢ (صنف محلى طراز هندي) وصنف الارز الاسود (صنف مستورد طراز يابانى) . سجل الصنف سخا ١٠٨ أفضل النتائج فى صفات الجوده كتصافى التقشير والتبيض و نسبه الحبوب السليمه مع محصول حبوب عالى بينما سجل الصنف جيزه ١٨٢ أعلى القيم فى المحصول ومكوناته . كان الأرز الأسود أعلى فى نسب كل من البروتين ، الرماد، الزيت ومحتوى المعادن (الحديد،الكاليسوم ،الزنك) مقارنه بالاصناف الاخرى. سجلت حبوب الارز البنيه للصنف سخا ١٠٨ أعلى القيم فى نسبه الالياف وكانت الحبوب البينيه لنفس الصنف الاعلى فى نسبه الكربوهيدرات. سجلت حبوب الارز البيضاء للصنف جيزه ١٨٢ أقل القيم فى نسبه المعادن ماعدا الكاليسوم وكذلك سجلت اعلى القيم فى كميه الماء الممتصه أثناء الطهى . استغرقت كل من الحبوب البنيه والبيضاء للأصناف سخا ١٠٨ وجيزه ١٨٢ نفس مده للطهي ، بينما استغرق صنف الارز الاسود مده أطول للطهى فى كلا الموسمين.

أسماء السادة المحكمين

أ.د/ صابر السيد صديق مركز البحوث الزراعية

أ.د/ محمود الدسوقى إبراهيم كلية الزراعة – جامعة المنوفية