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COOKING QUALITIES EVALUATION FOR WHITE AND BLACK RICE MIXTURE.

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ABSTRACT

Four rice varieties namely Giza 177, Sakha 105, Sakha 106 and Black rice were evaluated for physical, chemicals and cooking traits. Giza 177 (white rice) and black rice were mixed to three different mixed ratios (25% black rice: 75 % Giza 177), (50% black rice: 50 % Giza 177) and

(75% black rice: 25 % Giza 177), were analyzed for chemical, cooking characters and the mixtures were cooked to panel test. Rice cultivars indicated that the highest mean values of grain dimension traits were calculated for Black rice and the lowest one for Sakha 106 cultivar, also no significant difference between Black rice and Giza 177 were observed. No significant was found between the three white rice varieties for milling characters, while the black rice recorded the lowest one. Highly significant differences for cooking quality traits were recorded except in gelatinization temperature. Black rice' variety had the highest value in protein and ash while recorded the lowest values in fat and carbohydrate content .Highly significant differences between the two rice varieties and their mixtures in all the studied characters except in gelatinization temperature and moisture content, Panel test recorded that mix (25% black rice and 75% white rice) was the best and it increase the protein content with a little change in test

INTRODUCTION

White rice is the most common rice consumed by humans, followed by brown rice; also that rice genotypes with red, purple or black bran layer have been cultivated for a long time (Ahuja *et al*., 2007).However, milled or white rice, serves as the main source of carbohydrates for daily energy requirement. There are other forms or kinds of rice such as brown rice, pigmented rice, and micronutrient dense rice that offer additional health benefits. They are different in some aspect related to grain pericarp colour, shape, size, amylose content and aroma (Magalhães *et al*., 2012). As specialty rices their yields are usually lower than most commercial white rice varieties, but their economic and nutritional value is higher (Chaudhary and Duffy 2001) .Rices with black pericarp, usually named black rices are characterized by grains with dark purple pericarps with high levels of anthocyanins. During rice seed development, purple pigments of anthocyanin accumulate rapidly in the pericarp, resulting in the characteristic dark purple grains of black rice. (Rahman *et al*., (2013). Black rice is cultivated since ancient times. It is considered as a powerful antioxidant that has been demonstrated to reduce atherosclerotic plaque formation, a risk factor associated with cardiovascular disease (Ling *et al.*, 2001). On the same way, recent studies demonstrated that black rices could be easily considered as super food category because of its high levels of iron, essential amino acids, and fibers. Black rice can also be considered as a functional food because of being an important source of anthocyanin, a compound largely associated to antioxidant effects. Rice has many nutrient compositions including proteins, carbohydrates, some fatty acids vitamins and trace minerals. It is also a source of many bioactive non-nutrient compositions, like antioxidants, (Chanida et al., 2013). Many of the studies indicate that phytochemicals are bioactive compositions that contain phenylpropanoids, lignins, -oryzanol, tannins, tocopherols, tocotrienols, phenolics compounds and flavonoids. Most common groups of phenolic compositions are flavonoids which are water-soluble plant pigments with many colors (Hansakul *et al*., 2011). Flavonoid contents and phenolic compositions are potential ant oxidative phytochemicals that can act as metal ion chelators, free radical scavengers and reducing agents thus offer health advantages for human, and can be found in pigmented rice (Srisawat et al., 2010; Lum and Chong, 2012). Antioxidant activity and phenolic content of black rice is bigger than that of white rice (Higashi-Okai et al., 2008; Muntana and Prasong, 2010). (Higashi-Okai *et al*., 2008; Muntana and Prasong, 2010).

Flavonoid pigments in dark purple in rice kernel (the pericarp) and there are seven distinct kinds of anthocyanin, several of whom were recruited locally. Due to various localization types of these are not released and digested in same place and the same time in the digestive tract. The effects are felt over time. Additionally, anthocyanins that play in the fiber slow down the oxidation of nutrients which led to move more slowly through the digestive tract to be more completely processed. (Yukihiro et al., 2012). (Yukihiro et *al*., 2012).

This is an antioxidant found extensively in dark pigments of black rice that affects of gene expression of fat metabolism. And show off the storage fat gene expression and turns on to the process of fat metabolism gene expression. You can burn the fat rather than storing fat. That makes black rice effective and safe way of managing the weight (Takanori et *al*., 2006).

The aim of this study is evaluate the physical, chemicals and cooking trait properties of Egyptian white rice before and after mixing with black rice.

MATERIALS AND METHODS

Four rice varieties namely Giza 177, Sakha 105, Sakha 106 and Black rice were used in this study. Samples (Fresh harvested grains) from 2014 season were dehullled and polished at the grain quality Lab.,

RRTC. Sakha, Egypt. Samples were taken in random sampling (3 replication and 4 cultivars) completely randomized design in factorial arrangement was used in this experiment. About 150 grams (three replication) of rough rice for all samples were taken and well mixed and cleaned.

All samples were analyzed for the following grain quality characters:

- **Physical characters:** Grain length, width and shape were measured for paddy and milled rice grain according to Khush *etal*..(1979)
- **Milling characters:** Hulling%, Milling% and Head rice% were determine according to Adair (1952) by using Satake testing machines
- **Cooking and eating quality characters:** Gelatinization temperature (G.T.), amylose content and gel consistency test (G.C.) were estimated for milled rice samples following the methods of Little *et al*., (1958). Juliano (1971) and Cagampang *et al*. (1973) respectively.
- **Chemical compositions:** The rice flours were analyzed for the following chemical composition moisture content (%), protein content (%) (N X 5.95), lipids content (%), ash content (%), following the method described by A.O.A.C. (1990).standard method. Carbohydrate content was determined by difference.

  Carbohydrate (%) = 100% - (% moisture + fat + protein + ash)
- **Panel test:-** 100 g of milled rice from Giza 177 (white rice) and black rice and the three different mixed ratios (25%black ric:75 % Giza 177), (50%black ric:50 % Giza 177) and(75%black ric:25 % Giza 177), were analyzed for chemical and cooking qualities characters. Also, the mixtures were cooked served it to panel of 10 judges (5 male and 5 female) for evaluation. The samples were evaluated according to Peryam and Shapiro(1955) and using ten point scale for each characters with maximum score and of a limit of acceptability of score.

All collected data were subjected to analysis of variance according to Gomez and Gomez (1984). Treatments means were compared by Duncan's multiple range test (Duncan, 1955). All statistical analysis was performed using variance technique by means of "MSTAT" computer soft war package.

RESULTS AND DISCUSSION

Physical properties of a rice variety are estimated to provide important information in defining their suitable uses (Majzoobi and Farahnaky 2008). Results on grain length, grain width and grain shape characters of different rice varieties analyzed in this study showed significant differences in (Table 1). It is obvious that significant differences were found among the rice cultivars under study in grain length, grain width and grain shape characters in season of study. Additionally, the comparison among four cultivars clear that the highest mean values of grain length were calculated for Black rice and there no significant was found between Black rice, Giza 177 and Sakha 105 and the lowest values of the same trait were estimated for Sakha 106 cultivar.

Moreover, the highest mean values of grain width were recorded by Black rice. The lowest grain width was resulted by Sakha 106. In the universal market rice is characterized according to their grain sizes and shapes. The character of (L/W ratio) was performed to determine the shape of individual rice grains. Sakha 105 recorded the maximum grain shape. While the minimum value was found for Black rice, without significant difference with Sakha 106 and Sakha 105. Also no significant difference between Black rice and Giza 177. Therefore, we selected it to mixing together. In this study, all other rice varieties can be judged as medium. Determining the rice grain shape and width are important as both, cooking and eating traits are strongly affected by these (Mckenzie *et al*., 1983).Grain dimensions are controlled by genetic factor.

Table 1: Evaluation of grain shape characters of studied some paddy rice cultivars in 2014 season.

Cultivars (v)	Grain length (mm)	Grain width (mm)	Grain shape Length/ width
Black rice	7.91 a	3.62 a	2.19 b
Giza 177	7.85 a	3.39 b	2.31 b
Sakha 105	7.94 a	3.27 bc	2.43 a
Sakha 106	7.4 b	3.36 c	2.21 ab
F-test	*	**	*

*** ,** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively**

Results in (Table 2) indicated a significant difference among the four rice cultivars in respect to hulling %, milling % and head rice% in 2014. The de-hulling of rice is one of the important post harvest processes. If the hulling percentage is high, then the recovery of rice is also increased (Table 2). The hulling percentage for the four rice varieties under study, ranged from 76.67 to 81.77 %.The highest hulling percentage (81.77 %) was observed for both two varieties Sakha 105 and Sakha 106 and the lowest value was for black rice (76.67 %). The eighty percent or more are the desirable hulling characteristics for rice (Rita and Sarawgi 2008). Sakha 105 indicated the highest milled rice percentage. Black rice variety gave the lowest value, head rice recovery is one of the most important characters and more than 65% of head rice recovery is desirable. Head rice recovery value ranged from (58.91 - 66.80 %) in all the rice varieties evaluated during this study. The rice variety Sakha 106 showed highest head rice recovery among the four rice varieties and the lowest value for Black rice (58.91%), these results recorded no significant between Sakha 106 and Sakha 105 cultivars and also no significant differences were observed between black rice and Giza 177 cultivars in head rice%.

Table 2: Evaluation of milling recovery % characters of studied some paddy rice cultivars in 2014 season.

Cultivars (v)	Hulling %	Milled rice %	Head rice %
Black rice	76.67 b	65.77 b	58.91 b
Giza 177	79.76 a	69.75 a	59.56 b
Sakha 105	81.77 a	71.76 a	65.33 a
Sakha 106	81.77 a	71.12 a	66.80 a
F-test	*	**	*

*** ,** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively**

Amylose content can play important role in determining the overall cooking, eating and pasting properties of rice (Adu-Kwarteng *et al.*, 2003, Asghar *et al*., 2012). The cooking quality of rice can also be influenced by chemical compositions of rice like: proteins, lipids and amylopectin (Cai *et al*., 2011). In this study, Results in (Table 3) indicated that Sakha 105 had the lowest value of amylose content (17.13%) followed by Sakha 106 then Giza 177 and black rice recorded the highest value (20.87) . Sakha 105,Sakha 106 and Giza 177 with low amylose contents (10-20%) and Black rice with intermediate amylose content (20-25%) (IRRI, 1985). Variance in the amylose content between various rice varieties can also influence the cooking properties (Singh *et al*., 2005).

Table 3: Effect of some rice cultivars on some cooking and eating characters during 2014 season.

Cultivars (v)	Amylose content %	Gelatinization temperature (GT)	Gel consistency (GC)	Elongation %
Black rice	20.87 a	4.33	86.6 d	33.37 b
Giza 177	18.56 b	5.00	91.33 c	47.86 a
Sakha 105	17.13 c	5.67	93.33 b	53.27 a
Sakha 106	17.92 bc	5.33	95.67 a	53.18 a
F-test	**	Ns	**	*

*** ,** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively**

The gelatinization temperature (GT) of the rice samples have been classified as high, intermediate and low which means the temperature required for normal cooking time is below 70-74°C. And no significant difference with the four rice varieties under study. While the gel consistency (GC) of the rice samples was ranged between 86.6-95.67 mm and categorized as soft, this means the tendency of cooked rice to be soft on cooling. The GC is categorized into soft, medium and hard. Among the traditional rice varieties, the extended of rice flour was highest in Sahka 106 (95.67 mm). In this study elongation of rice kernel %., maximum elongation ratio was observed in Sakha 105(53.27) followed by Sakha 106 (53.18), Giza 177 (47.86) then black rice (33.37). No significant was found among Sakha 105, Sakha 106 and Giza 177, but the nearest value to Black rice is Giza 177, therefore we choice it to mixing together. Elongation of rice can be influenced by grain shape and the amylose contents (Singh *et al*., 2005; Danbaba *et al*., 2011).

The results realized for chemical composition of different rice varieties suggested in this study are found in (Table 4). Significant differences were recorded in the chemical composition between different varieties of rice evaluated. Moisture content, which plays a significant role in determining the shelf-life (Webb, 1985) was recorded to vary between 12.63% to 14.29%. The ash content was high in black rice (1.130%) and low in SaKha 106 (0.648%). There were no significant differences recorded for the three rice varieties under study in ash content. The amount of ash present in a food sample plays an important role while determining the levels of essential minerals (Bhat and Sridhar, 2008). Protein content for all the rice varieties evaluated ranged between 6.59% to 10.67%, and high protein content was recorded in black rice variety (10.67 %), while fat content ranged between 0.914% up to 1.187%. Overall, low fat content was recorded in black rice variety (0.914%).These results were agreement with Thomas *et al*.,(2013). Thomas et al (2013) reported that 'Black rice' variety had the highest protein content with lowest fat content. .Carbohydrate content was high in four cultivars (> 70%) but, the lowest value was found in Black rice and hence can be considered rice to be a good source of carbohydrate.

Table 4: Effect of some rice cultivars on chemical composition characters during 2014 season.

Cultivars (v)	(Moisture %)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Black rice	12.63	1.13 a	10.67 a	0.914 b	73.72 b
Giza 177	13.60	0.687 b	6.59 b	1.183 a	78.61 a
Sakha 105	14.26	0.668 b	6.73 b	1.134 a	77.10 a
Sakha 106	14.29	0.648 b	6.66 b	1.187 a	77.28 a
F-test	Ns	**	**	**	**

***, ** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively**

(Table 5)Significant differences among grains of the two rice cultivars and their mixes were achieved for amylose content character under study. Results cleared that the highest values were found for milled rice grains of Black rice (20.87%) (Intermediate), while the lowest values were Mix 1(25% Black rice and75% Giza 177), Mix 2(50% Black rice and50% Giza 177) and Mix 3(75% Black rice and25% Giza 177). found for Giza 177 rice and Mix 1(18.56and 18.73% respectively). While rice grains of the two mixes have low amylose content. (Table 5) Results in (Table 5) indicated that By increasing quantities of white to black rice decreased Amylose content %,compare to black rice (intermediate amylose content%), but no significant was found between the three mixes under study (low amylose content %). And there was no significant Gelatinization temperature and Gel consistency between two varieties and their mixes,

Table 5: Effect of some rice cultivars and their mixes on some cooking and eating characters during 2014 season.

Cultivars (v)	Amylose content %	Gelatinization temperature (GT)	Gel consistency (GC)	Elongation %
Black rice	20.87 a	4.33	86.6 d	33.39 e
Giza 177	18.56 d	5.00	91.33 a	47.86 a
Mix 1	18.73 d	4.67	90.00 b	44.34 b
Mix 2	19.35 c	4.67	88.33 c	40.60 c
Mix 3	19.8 b	4.00	86.0 d	40.60 d
F-test	**	Ns	**	**

*** ,** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively.**

Results in (Table 6) indicated that by increasing quantities of black rice variety increased compounds of Protein, and ash, while decreased fat compound when compared to white rice Giza 177. From these results under this study black Rice is highly nutritious In comparison with other white rice varieties. Black Rice is very rich in protein and Ash while low in fat (necessary for a healthy and regulated digestive system), as well as a host of other crucial minerals. Focus on black rice and make maxes with white rice sprouted white rice well-balanced "super-foods" truly remarkable in its abilities. It can be taken as a complete meal, a nutritional supplement.

Table 6: Effect of some rice cultivars and their mixes on chemical composition characters during 2014 season..

Cultivars (v)	(Moisture %)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Black rice	12.63	1.13 a	10.67 a	0.9.14 b	73.72
Giza 177	13.60	0.687 c	6.59 c	1.183 a	78.61
Mix 1	14.11	0.795 bc	7.30 c	1.16 ab	77.48
Mix 2	13.79	0.896 b	8.27 b	1.18 bc	76.76
Mix 3	13.43	1.07 a	9.21 b	1.14 c	76.23
F-test	Ns	**	**	**	**

*** ,** and Ns significant at 0.05 and 0.01 probability levels and not significant, respectively Mix 1(25% Black rice and75% Giza 177), Mix 2(50% Black rice and50% Giza 177)and Mix 3(75% Black rice and25% Giza 177),**

Table 7: Palatability characters of some rice cultivars and their mixes.

Rice cultivars	Rice/water ratio	Before cooking			Cooking Time- min	Oder	Whiteness	Expansion	Hardness	Stickiness	Taste	Total-100
		Grain length	Grain shape	Trans.								
Giza ١٧٧	١:١.٢٥	Medium ٨	Medium ٨	Trans ٨	٣٠٦-٢٠	No ١٠	White ٦	Half ٦	Unbroken ١٠	Fluffy ١٠	Good ٩	٨١
Black rice	١:١.٢٥	Medium ٨	Medium ٧	Half Chalky ٥	More than 30٣	Strong ٣	Dark ٢	Half ٦	Unbroken ٩	Fluffy ٨	Accepted 5	٥٦
Max ١	١:١.٢٥	Medium ٨	Medium ٨	Half Chalky ٦	٣٠٦-٢٠	Medium ٥	Dark ٢	Half ٦	Unbroken ١٠	Fluffy ٩	Good ٧	٦٧
Max ٢	١:١.٢٥	Medium ٨	Medium ٧	Half Chalky ٦	More than 30٣	Strong ٣	Dark ٢	Half ٦	Unbroken ١٠	Fluffy ٨	Accepted 5	٦٠
Max ٣	١:١.٢٥	Medium ٨	Medium ٧	Half Chalky ٦	More than 30٣	Strong ٣	Dark ٢	Half ٦	Unbroken ١٠	Fluffy ٨	Accepted 5	٥٨

Mix 1(25% Black rice and75% Giza 177), Mix 2(50% Black rice and50% Giza 177 (and Mix 3(75% Black rice and25% Giza 177),

Data recorded in (Table 7) and illustrated the palatability characters of two rice varieties i.e Giza 177 and Black Rice and some mixtures between them, to increase the nutritional value of Giza 177 variety.

Rice to water ratios was constant to al treatments at 1:1.25.

Grain shape and translucency before cooking for Giza 177 variety was the best while black rice was the least due to it dark color. Giza 177 milled rice and

mixture 1 recorded same cooking time and lower than black rice and the other two mixtures 2014.

Due to its genetic back ground, Black rice had a strong odor than Giza 177 variety and therefore its mixture were affected by these oders. The whiteness of rice after cooking affected directly by black colure of Black rice variety its clear from data in (Table 7). Volume expansion and hardness of both two milled rice varieties and its mixtures were not affected after cooking as shown in (Table 7).

Giza 177 variety was more stickiness than Black rice and its mixtures due to its highest value of gel consistency for Giza 177. Mixture 1 (25% Black Rice and 7% Giza 177) recorded the second two good taste (Table 7) followed by Giza 177 variety. So, this study recommended that we can increase the nutritional value of white rice by mixing with 25% Black rice without any big change in taste.

CONCLUSION

It could be concluded that Black rice' variety had the highest protein content with lowest fat content. Results suggests in this study might be able to mix white rice with black rice to get highest protein quality of rice (marketed in Egypt based on their chemical composition as well as on their physiochemical and cooking properties

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تقييم جودة الأرز الأبيض عند خلطه بالأرز الأسود بعد الطهي

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قسم بحوث الأرز بسخا- كفر الشيخ معهد بحوث المحاصيل الحقليه -مركز البحوث الزراعية

***قسم بحوث التعبئه والتغليف بسخا - كفر الشيخ معهد بحوث علوم تكنولوجيا الأغذيه -مركز البحوث الزراعية**

تم تقييم أربعه أصناف من الأرز وهي جيزه ١٧٧، سخا ١٠٥،سخا ١٠٦ والأرز الأسود تحت تنفيذ التجربه العامليه في تصميم تام العشوائيه في ثلاثه مكررات وكانت الصفات المختبره هي بعض الصفات الطبيعيه ،الكيماويه،وصفات الطهي والأكل .ثم تم إختيار صنف الأرز جيزه ١٧٧ وذلك لتقاربه مع الأرز الأسود في الشكل والحجم ،ثم تم عمل ثلاثة خلطات من صنف الأرز جيزه ١٧٧ و الأرز الأسود بنسب ٢٥% ، ٥٠%، ٧٥% من الأرز الأسود وتم عمل الأختبارات السابقه ثم إجراء إختبار الطهي والتذوق لهذه الأصناف والخلطات وتم تنفيذ التجربه العامليه في تصميم تام العشوائيه في ثلاثه مكررات ويمكن تلخيص أهم النتائج فيما يلي:

أعلي قيمه في شكل الحبة لصنف الأرز الأسود بينما كان صنف سخا ١٠٦ اقلهم كما لم يوجد فرق معنوي بين الأرز الأسود وصنف جيزة ١٧٧ ولم يوجد أي اختلافات معنوية في صفات الضرب والتبيض بين الأصناف الثلاثة وكان الأرز الأسود فقط هو الأقل في نسبه الضرب والتبيض ثم تسجيل فروق معنوية في صفات الطهي والأكل بين الأصناف تحت الدراسة إلا في صفه درجه حرارة الجلتنه وبالنسبة للتركيب الكيماوي فقد احتوي الأرز الأسود علي اعلي نسبه في البروتين والرماد بالنسبة للأصناف الأخرى بينما كان أقلهم في محتوي الدهون والكربوهيدرات

وفي حاله خلطات الأرز أظهرت النتائج وجود فروق معنوية عاليه بين صنفي الأرز والثلاث خلطات في جميع الصفات فيما عدا درجه حرارة الجلتنه ونسبه الرطوبة فقط.

اظهر اختبار التذوق انه يمكن استخدام مخلوط الأرز الأبيض مع ٢٥% من الأرز الأسود مع تغير قليل في الطعم وسيؤدي ذلك الي رفع نسبه البروتين في الأرز المطهي