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PHYSICOCHEMICAL AND COOKING QUALITY CHARACTERISTICS OF NEW EGYPTIAN RICE VARIETIES

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ABSTRACT

Rice (*Oryza sativa* L.) is the second most main cereal crop, and the major source of nutrition for half of the world's population. The physicochemical properties, nutritional value, milling quality and organoleptic properties of Super 301, Sakha 109 and Sakha 102 Egyptian rice varieties (brown and white) were estimated. The obtained results showed that Sakha 102 rice variety had the longest grain and the lowest width compared to the other tested varieties. In addition, white rice greatly outperformed brown rice in terms of water uptake and sedimentation. Among all the samples tested, the brown Sakha 109 rice sample required the greatest time to cook (41 minutes). In comparison to the other white rice varieties, Super 301 exhibited the highest gel consistency, alkali-spreading value, and elongation percentage. In comparison to white rice, brown rice exhibited a lower quantity of readily available carbohydrates but higher concentrations of ether extract, ash, and crude protein. The Super 301 rice variety had relatively high levels of mineral content in brown and white rice compared with the other rice varieties. Among all the rice samples evaluated, the cooked white rice of the Super 301 rice type obtained the highest mean scores for organoleptic attributes. Finally, it can be recommended to increase the cultivated area of the Super 301 and Shakha109 varieties, since it has the best physical, chemical, nutritional and acceptable organoleptic properties.

INTRODUCTION

The biggest worldwide environmental challenges of the 21st century include climate changes. Moreover, 50% of the world's population depends mostly on rice as a cereal crop. The burning of rice straw after harvest and other rice cultivation techniques are known to be substantial sources of greenhouse gas emissions, particularly methane. Rice is only grown on about 650,000 ha (3.3% of Egypt's total arable area). This shows that 20% of Egypt's total arable land is dedicated to the cultivation of rice. Egypt depends on the Nile for 97% of its water needs (**Elbasiouny and Elbehiry, 2020**).

Brown rice, hull, white rice, and bran are the four fractions of whole rice that are white before being sold. White rice is inferior to brown rice in terms of nutrition. Unlike other foods, white rice contains larger percentages of all nutrients except for carbs **(Meera *et al*., 2019).** Brown rice, is unpolished rice that has been converted into a whole grain. Since brown rice contains many nutrients like protein, fat, dietary fiber minerals, and vitamins, it is beneficial for human health **(Abd El-Sattar *et al*., 2016**). The quality of the milling process has been evaluated from a marketing standpoint based on head rice and total milling, and it is an important component. The majority of broken grains created

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during milling is typically caused by immature, fissured kernels or chalky, all of which are weak and frequently break during milling due to the high forces applied on kernels in order to remove bran **(Siebenmorgen *et al*., 2013).**

Rice quality is influenced by the variety, pre- and post-harvest cultivation, and processing methods. According to **Akoa-Etoa *et al*. (2016),** rice preferences and price willingness of consumers are influenced by its look, organoleptic quality, and nutritional quality. Consumer also seek for rice that is recognized to have short cooking times, high volume expansion ratios, thin shapes, and a natural "popcorn" aroma after cooking **(Demont *et al*., 2017).** The primary aim of the consumer is to obtain rice that is suitable for both cooking and eating; the characteristics of rice is based on the physicochemical characteristics of starch, which represents 90% of powdered rice. The amylose content, water absorption, volume expansion, gel consistency, and final starch gelatinization temperature have their impact on how well rice cooks and tastes when eaten **(Bao, 2012).**

Rice is a versatile, wholesome and healthy food. The body's digestive systems transform its complex carbohydrate content into glycogen. Glycogen is kept in muscle tissue where it is released as needed to fuel an activity. The typical Egyptian consumes 35 to 40 Kg of rice annually because it is a staple diet **(Elbasiouny and Elbehiry, 2020).** In Egypt, where more than 95% of the rice area is farmed, preparing and eating high-quality rice has never been a big problem because to the moisture, tenderness, gloss, and flavor of Japonica rice varieties. Due to the focus on producing long-grain Indica rice, a breeding program's problem with cooking and eating quality has received more attention **(El-Hissewy and El-Kady 1992).**

The purpose of the current study is to compare the novel rice grain types (Super 301 and Sakha 109) grown in Egypt to traditional rice (Sakha 102) in order to assess the quality features (physicochemical, milling properties, nutritional value, cooking and eating qualities).

MATERIALS AND METHODS

Materials

In this study, three types of Egyptian rice (*Oryza sativa* L.), Super 301, Sakha 109, and Sakha 102, were used. In the season of 2021, samples of rice were collected from the Rice Research and Training Center (RRTC) in Sakha, Governorate of Kafr El-Sheikh, Egypt, under the suggested cultivation, harvesting, and irrigation schedules.

Methods

Brown and White Rice Preparation of Different Varieties

The brown rice was obtained by hulling samples of paddy rice. Two portions of brown rice were separated; the first was utilized to make brown rice, while the second was white to make white rice. The brown and white rice was preserved in plastic bags and kept in the freezer at -18^{o}C prior to further examination.

Physical Characteristics of Rice Varieties

The length and width of the grain, the grain's shape (the ratio of grain length to grain width), and the grain's index were all measured. To calculate the grain dimensions (mm), 10 uniform rice grains were randomly selected, and their length and breadth were measured twice under a microscope with a 0.001 mm precision **(Suwansri and Meullenet, 2004).** According to **Ahuja *et al*. (1995)** ten randomly selected grains of rice were used to determine the grain shape by dividing the length by the width. According to **Khush *et al*. (1979**) 1000 grains of each rice type were counted randomly in duplicate, weighed individually, and the grain index (g/1000g) was determined. Rice's bulk density was calculated using the **Fraser *et al.* (1978)** method.

Milling Features of Rice Varieties

Three different varieties of cleaned rough rice, Super 301, Sakha 109, and Sakha 102, totaled 150 g. SATAKE Laboratory Dehuller was used to dehull them. The method of **Khan and Wikramanayake (1971**) was applied to calculate the total white rice, hulls, heads, brown rice, and broken percentages.

Water Uptake, Sedimentation Values and Cooking Time of Rice Varieties

Brown and white rice types' water intake, sedimentation values (77 and 82^{o}C), and cooking times were calculated using **Simpson *et al.* (1965)** methods.

Determination of cooking quality

According to the procedure outlined by **Bhattacharya and Sowbhagya (1980)** the alkali spreading value was calculated. The **Cagampang *et al*. (1973)** described method was used to determine gel consistency (GC). The **Tomar (1985)** technique was used to measure the elongation percentage. The amylose content was determined using the **Juliano *et al.* (1981)** technique.

Chemical composition of rice varieties

The following characteristics were assessed using the **AOAC (2012)** procedures, code (817542290): moisture, ether extract, ash content, crude protein, and crude fiber. Additionally, the amount of accessible carbohydrates calculated by subtracting protein, ash, ether extract, and crude fiber from the total mass.

Determination of minerals contents of rice varieties

Rice samples were prepared for mineral analysis using the **AOAC (2012)** technique, code (817542290). Using the colorimetric approach outlined by **Murphy and Riley (1962).** The ascorbic acid methodology was used to measure total phosphorus. Rice samples' potassium and sodium contents were measured using a flame photometer, per **Pearson (1976)** instructions**.** Rice samples' concentrations of iron, copper, zinc, and calcium were measured using an atomic absorption spectrophotometer (Perken Elmer Model 2180).

Organoleptic properties of rice varieties

White and brown cooked rice were assessed for their organoleptic qualities. To evaluate the samples, a panel of 20 evaluators was assembled. The panellists were asked to rank the items' flavor, texture, color, and general acceptability on a scale of one to ten using **El-Bana *et al.* (2020)**. One being (very dislike) to 10 beings are the possible scores (like extremely).

Statistical Analysis

According to **Stell and Torrie (1980)** instruction, the majority of the gathered data were statistically analyzed using variance analysis with a 5% significance level and the means were further examined using the lowest significant difference test (LSD).

RESULTS AND DISCUSSION

Physical Properties of Rice Varieties

According to results shown in Table 1, white rice grains ranged in length from 5.28 to 5.95 mm, whereas brown rice grains ranged from 5.32 to 6.26 mm. Sakha 102 rice was significantly the longest of all the rice varieties. The three different rice types (Super 301, Sakha 109, and Sakha 102) had brown rice grains that were 3.95, 3.85, and 2.86 mm wide, compared to white rice grains that were 3.75, 3.81, and 2.70 mm wide, respectively. These findings follow the same general pattern as those made public elsewhere **(Abd El-Sattar *et al.*, 2016;**

Table 1. Physical properties of some rice varieties

Rice variety	Treatment	Physical property				
		Grain dimension		Grain shape	Grain index** (g)	Bulk density (g/cm^3)
		Length (mm)	Width (mm)			
Super 301	Brown	5.54 ±.02^c	3.95±.02^a	1.40± .02^e	34.10±2.00^a	0.80±.02^c
	White	5.32±.02^d	3.75 ±.03^d	1.42±.01^d	28.10±1.00^{bc}	0.81±.02^{bc}
Sakha 109	Brown	5. 55 ±.03^c	3.85 ±.03^b	1.44±.01^c	32.22± 3.00^{ab}	0.83±.03^{bc}
	White	5.28±.03^e	3.81±.01^c	1.39±.02^e	25.22 ±2.00^c	0.85 ±.02^b
Sakha 102	Brown	6.26±.04^a	2.86±.03^e	2.19± .02^b	26.86±3.25^c	0.84±.03^b
	White	5.95±.02^b	2.70±.01^f	2.20±.02^a	20.51±4.00^d	0.90±.02^a

* Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences (p<0.05).

El-Bana *et al*., 2020). Grain morphological characteristics was presented in Table 1 for the three rice varieties (Sakha 102, Super 301, and Sakha 109) for both brown and white rice. The detected differences were significant at P≤0.05. However, as described by **Ahuja *et al*. (1995),** who categorized the shape as Medium (2.1-3.0), Slender (> 3.0), Round (≤1.0), and Bold (1.1-2.0). The shape of the rice grain also be influenced by the ratio between length and breadth. The current outcomes are reliable with those of **Gewaily *et al*. (2019).** It is also clear from the same results that the grain index values for the three rice varieties (Super 301, Sakha 109, and Sakha 102) for brown and white rice were (34.10, 32.22, and 26.86 g); (28.10, 25.22, and 20.51g), respectively. Additionally, the information in the similar Table presented that samples of white rice had a larger bulk density than samples of brown rice. It is also clear from the aforementioned statistics that milling caused a significant rise in bulk density while grain index values showed a noticeable decrease. The results in this regard matched the conclusions of several researchers **(El-Bana *et al*., 2010 ; Gewaily *et al*., 2018)**.

Milling Features of Rice Varieties

The statistics in Table 2 show that the three rice types (Super 301, Sakha 109, and Sakha 102) had hull percentages that varied from 17.40 to 19.30%. The same table makes it clear that there were considerable differences in brown rice recovery between the samples. The maximum brown rice recovery percentage was that of Super 301 rice (82.60%), while the lowest percentage was found in Sakha 102 rice (80.80%). Regarding the proportion of white rice, samples of Super 301 shown an earlier rise in the aforementioned factor as compared to other types. Head rice recovery of paddy is inversely proportional to broken percentage recovery because a low broken percentage in the sample results in a high head rice recovery (**Chavan *et al*., 2016**). The percentages of head and broken rice varied according to the length and width of the various rice kinds, as indicated in Table 2. Sakha 102 has lower percentages of damaged rice than Sakha 109 and Super 301. These outcomes followed the same pattern as those noted by **Abd El-Rassol *et al*. (2005); Gewaily *et al.* (2019) and El-Bana *et al*. (2020).**

Table 2. Milling features of some rice varieties

Rice variety	Hulls (%)	Milling features (%)			
		Brown rice	White rice	Head rice	Broken rice
Super 301	17.40 ±0.30[c]	82.60 ±030[a]	75.30 ±0.35[a]	68.90 ±0.30[a]	6.40 ±0.31[ab]
Sakha 109	18.30±0.40 [b]	81.70±0.10[b]	72.10 ±0.40[b]	65.50±0.20[b]	6.60±0.20[a]
Sakha 102	19.30±0.20[a]	80.70±0.40[c]	71.40 ±0.20[c]	65.40±0.10[b]	6.00±0.10[b]

* Values are expressed as mean of 10 measurements followed by the standard deviation. a–e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$).

Water Uptake, Sedimentation Value and Cooking Time of Some Rice Varieties

Rendering to the findings in Table 3, samples of white rice absorbed more water at 77 and 82°C than those of brown rice. This might be due to the removal of minerals, protein, lipids and protein of brown rice with the removal of the outer layers of the grain". Or refer to the bleaching or milling in another way. **Abd El-Sattar *et al*. (2016)** discovered that Starch might be a clue for more water binding. Additionally, across all of the analyzed rice samples, the white rice variety Super 301 had the maximum water uptake value at 77 and 82°C. The same table also makes it evident that compared to brown rice samples, white rice samples exhibited higher sedimentation values at 77 and 82°C. Additionally, sedimentation values at 82°C were higher for numerous rice varieties than they were at 77°C. Sakha 109, a brown rice variety, also showed the lowest sedimentation value among the rice varieties tested (1.14 and 1.53 ml sed./100 g rice, respectively) at 77 and 82°C.

The amount of time needed to completely remove the opaque center of the rice grain during cooking is known as the cooking time **(Itagi and Singh, 2015).** The results of the same table show that brown rice needed more time to cook than white rice. Additionally, of all the rice samples evaluated, the Sakha 109 brown rice variety's cooking time was comparatively the longest (41 min.). While all of the rice samples tested took the least amount of time to cook, Super 301 white variety (21 min.). The results were consistent with those published by **Gewaily *et al*. (2019) and El-Bana *et al*. (2020)**.

Cooking Quality Properties of Rice Varieties

The amylose content, water absorption, volume expansion, gel consistency, and final starch gelatinization temperature have their impact on how well rice cooks and tastes when eaten **(Bao, 2012).** According to the results in Table 4, both white and brown rice varieties differed greatly in terms of gel consistency (GC). Brown rice has a lower GC content than white rice. Brown and white rice from the rice variety Super 301 had the maximal GC, followed by rice from Sakha 102 and Sakha 109. **Perez and Juliano (1981)** came to the conclusion that the GC of white rice was an accurate gauge of gel viscosity, which served as a proxy for the cooked rice's texture. The link between amylograph consistency and gel viscosity makes it possible to use the latter as a tool for quick screening of consumption quality in a rice background programmed. These results are in line with what was found by **El-Bana *et al.* (2007) and Wafaa *et al.* (2019)**. The gelatinization temperature of the rice starch

Table 3. Water uptake, sedimentation value and cooking time of some rice varieties

Rice variety	Treatment	Water uptake (ml H_2O/100 g rice)		Sedimentation value g sed./ 100 g rice)		Cooking time (min.)
		77 °C	82°C	77°C	82°C	
Super 301	Brown	241.33±0.91[c]	266.40 ±0.93[c]	1.45±0.07[c]	1.78±0.05[c]	35±0.42[b]
	White	268.64 ±0.75[a]	301.51±0.85[a]	1.78±0.08[b]	2.38±0.08[b]	21±0.39[e]
Sakha109	Brown	219.21±0.84[e]	243.24±0.95[e]	1.14±0.09[c]	1.53±0.05[c]	41±0.31[a]
	White	247.00±0.86[b]	281.31±0.89[b]	2.34±0.04[a]	2.72±0.07[a]	26±0.41[d]
Sakha102	Brown	210.14±0.88[f]	233.57±0.76[f]	1.71±0.04[b]	1.90±0.06[bc]	31±0.31[c]
	White	233.33±0.90[d]	263.22±0.89[d]	2.34±0.07[a]	2.74±0.08[a]	23±0.37[e]

* Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$).

Table 4. Cooking quality of some rice varieties

Rice variety	Treatment	Cooking quality			
		Gel consistency (mm) (GC) **	Alkali spreading value (GT) *	Elongation (%)	Amylose (%)
Super 301	Brown	92.51±0.80[c]	5.40±0.30[cd]	69.54±1.20[b]	17.94±0.18[d]
	White	96.86±1.20[a]	6.70±0.30[a]	72.21±1.10[a]	19.04±0.25[b]
Sakha109	Brown	89.50±1.60[d]	4.80±0.10[d]	67.01±0.25[c]	17.30±0.32[e]
	White	94.70±0.40[b]	6.10±0.20[b]	69.87±1.1[b]	18.55±0.27[c]
Sakha 102	Brown	90.30±1.20[cd]	5.40±0.30[cd]	69.41±0.72[b]	19.33±0.34[b]
	White	95.80±1.40[ab]	6.40 ±0.20[ab]	72.30±1.00[a]	20.61±0.33[a]

* Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$).

*Gelatinization temperature (GT): Rating of 1-3= high GT (greater than 74ºC), Rating of 4-5= intermediate (70-74ºC) and Rating of 6-7= low GT (low 70ºC);

**Gel consistency (GC): Hard (27- 40 mm), medium (41-60 mm) and soft (61-100 mm).

molecules is determined using the alkali spreading value as an inverse indication. Table 4 provides the results of the alkali spreading value. Compared to white rice types, brown rice varieties' alkali spreading values were lower. The Super 301 variety of white rice has the highest percentage of alkali spreading value (6.70%). In Table 4, the elongation percentages of cooked rice are displayed. For all varieties, white rice has greater values than brown rice. This was anticipated given the significant amount of water added to white rice varieties. Additionally, the brown Sakha109 variety had the lowest level of elongation value (67.01%), while the white Sakha 102 rice variety had a comparatively high level of elongation value (72.30%).

Rice's capacity to be cooked, consumed, and pasted is significantly influenced by the amount of amylose present in it **(Asghar *et al.*, 2012).** The results in Table 4 besides showed that crushing was one of the key elements that contributed to raising the amylose content of different rice varieties. As a result, all forms of white rice had higher amylose concentrations than brown rice. As a result, Sakha 102 variety white rice grains had the highest amylose content (20.61%). Whereas the Sakha109 kind of brown rice has the lowest rating at 17.30%. The outcomes are consistent with those of **Osman and Abd El-Galeel (2008) and Fatma and Soheir (2021).**

Chemical Composition of Some Rice Varieties

According to information shown in Table 5, the moisture contents of the two types of rice, brown and white, ranged from 11.01 to 12.26%. Additionally, the moisture content of the brown rice was higher than of white rice for the three rice varieties that were studied. These values are consistent with those of **Abd El-Sattar *et al*. (2016**). When keeping rice, moisture content, ether extract, crude protein, and ash all tended to drop with milling for the varieties of rice that were studied. The removal of the embryo and bran layers, which was result in a decrease in the amount of ether extract, crude protein, and ash present in these parts, may help to explain this (**Amorim *et al*., 2004**). The same results showed that the Sakha 109 variety of brown rice had the highest crude protein content (8.90%), whereas the Sakha 109 type of white rice had the lowest value (6.56%). The results from the same Table also demonstrated that there were highly significant differences in ether extract among different varieties of rice as well as between brown and white rice from the same type. The lowest ether extract concentration was found in white rice from the Sakha 102 variety (0.82%), while the highest concentration was found in brown rice from the Sakha 109 variety (2.42%). According to **Pal *et al*. (1999**), the amount of surface fat was inversely associated to milling intensity. When determining the mineral content of rice, ash content is crucial **(Bhat and Sridhar, 2008**).

Additionally, within the same species of rice, brown and white rice, there were considerable changes in ash concentration between the different types. Additionally, for both brown and white rice, the Sakha109 variety had the greatest ash concentration (1.35 and 0.81%, respectively). According to **Amorim *et al*. (2004),** the amount of ash revealed the presence of specific minerals. According to the information in the same Table, Sakha109, a white rice variety, had the highest available carbohydrate content for both brown and white rice when compared to the other samples that were put to the test. Additionally, milling enhanced the rice samples' carbohydrate content. These results might be attributed to the removal of the embryo and bran layer, which results in white rice that is low in fat, ash, crude protein, and fiber. As a result, white rice will have more readily available carbs than brown rice. The outcomes were in line with those reported by **Paiva *et al.* (2016); Fatma and Soheir (2021) and Awad-Allah *et al*. (2022)**.

Minerals Content of Some Rice Varieties

In addition to being crucial for human nourishment, several minerals and elements are also necessary for other body parts, such as haem for blood (**National Academy of Sciences, 2001)**. In some ways, the ash level of different rice varieties was significant since it included nutrients like minerals. Table 6 lists a few of these. Out of all the determined mineral contents, potassium content was the highest. Additionally, brown rice was the rice sample with the highest mineral content. As opposed to other rice types, Super 301 exhibited comparatively high levels of mineral content in both its brown and white rice. The results are in line with what was stated by **Abd El-Rassol *et al*. (2005) and Fatma and Soheir (2021).**

Table 5. Chemical composition (% on dry basis) of some rice varieties

Rice variety	Treatment	Chemical composition (%)					
		Moisture	Crude protein	Ether extract	Ash	Crude fiber	A.C. **
Super 301	Brown	11.41±0.13^{c}	8.54±0.19^{b}	2.06±0.08^{b}	1.34±0.16^{a}	1.36±0.08^{a}	86.70±0.53^{d}
	White	11.01±0.22d	7.50±0.24^{d}	0.84±0.03^{d}	0.70±0.17^{b}	0.75±0.03^{d}	90.21±0.46^{b}
Sakha109	Brown	12.26±0.16^{a}	7.44±0.09^{d}	2.42±0.05^{a}	1.35±0.14^{a}	1.00±0.05^{c}	87.79±0.57^{c}
	White	11.81±0.33^{b}	6.56±0.26^{e}	0.91±0.07^{d}	0.81±0.12^{b}	0.37±0.06^{f}	91.35±0.56^{a}
Sakha102	Brown	11.87±0.24^{b}	8.90±0.08^{a}	1.86±0.05^{c}	1.28±0.14^{a}	1.27±0.07^{b}	86.69±0.57^{d}
	White	11.34±0.15^{cd}	8.03±0.17^{c}	0.82±0.11^{d}	0.62±0.13^{b}	0.54±0.05^{e}	89.99±0.49^{b}

Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$).

A.C. ** Available carbohydrates were calculated by difference.

Table 6. Minerals content (mg/100g) of some rice varieties

Rice variety	Treatment	Mineral content (mg/100g)						
		P	K	Na	Ca	Fe	Zn	Cu
Super 301	Brown	0±0.03^{a}	176.30±2.89^{a}	31.32±0.27^{a}	34.92±0.42^{a}	2.21±0.04^{a}	1.74±0.02^{a}	0.65±0.02^{b}
	White	21±0.02^{b}	86.70±1.78^{e}	9.71±0.38^{d}	13.90±0.18^{d}	1.74±0.03^{c}	0.95±0.03^{d}	0.53±0.03^{c}
Shakha109	Brown	33±0.01^{a}	169.98±2.87^{b}	28.61±0.29^{b}	33.82±0.32^{b}	2.00±0.02^{b}	1.29±0.03^{b}	0.72±0.01^{a}
	White	5±0.04^{b}	98.40±1.70^{d}	10.01±0.37^{d}	12.83±0.13e	1.53±0.02^{d}	0.96±0.02^{d}	0.53±0.04^{c}
Shakha102	Brown	32±0.02^{a}	155.21±0.96^{c}	25.61±0.34^{c}	23.52±0.26c	1.76±0.01^{c}	1.14±0.04^{c}	0.56±0.02^{c}
	White	19±0.04^{b}	73.96±0.84^{f}	8.59±0.31^{e}	11.92±0.24^{f}	1.33±0.03^{e}	0.86±0.04^{e}	0.40±0.03^{d}

* Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$).

Organoleptic Evaluation of Some Rice Varieties

Table 7 presents the organoleptic evaluation of different studied rice varieties. The statistics showed that cooked white rice had higher color score than cooked brown rice, with Super 301 having the highest color score out of all the tested varieties. The key component determining whether a product is liked or disliked is flavor, which is a combination of taste and smell. One of the most important factors in customer acceptance of a product is the taste, which is influenced by flavor **(Durgrao *et al.*, 2017**).

Additionally, the same Table demonstrated that cooked brown rice has less flavor than cooked white rice. Additionally, the Shakha 109 variety of cooked white rice earned the greatest flavor ratings in comparison with all of the other rice samples. It must be celebrated that the texture of the various cooked rice samples varied, with white rice having a somewhat better texture than cooked brown rice. Comparing all rice samples, brown rice (Shakha109 type) obtained the lowest texture rating. The Super 301 white rice type earned the greatest acceptability score out of all the cooked rice samples, according to the mean values for overall acceptability. These findings

Table 7. Organoleptic properties of cooked brown and white rice varieties

Rice variety	Treatment	Organoleptic properties			
		Color	Flavor	Texture	Overall acceptability
Super 301	Brown	7.95 ± 0.25^{b}	7.75 ± 0.78^{b}	8.11 ± 0.90^{ab}	7.94 ± 0.80^{b}
	White	8.92 ± 0.38^{a}	8.55 ± 0.60^{a}	8.40 ± 0.60^{a}	8.62 ± 0.55^{a}
Shakha109	Brown	7.70 ± 0.70^{b}	7.45 ± 0.34^{bc}	7.9 ± 0.66^{b}	7.68 ± 0.44^{b}
	White	8.51 ± 0.88^{a}	8.80 ± 0.58^{a}	8.24 ± 0.48^{a}	8.52 ± 0.82^{a}
Shakha102	Brown	7.33 ± 0.33^{bc}	7.90 ± 0.77^{b}	8.10 ± 0.82^{ab}	7.78 ± 0.74^{b}
	White	8.82 ± 0.55^{a}	8.45 ± 0.49^{a}	8.41 ± 0.67^{a}	8.56 ± 0.49^{a}

* Values are expressed as mean of 10 measurements followed by the standard deviation. a−e (or so on) different superscripts within the same column indicates significant differences ($p<0.05$)

were confirmed since cooked white rice exhibited superior qualities than samples of brown rice in terms of texture, color, flavor, and general acceptance. The outcomes are consistent with what was described by **Abd El-Sattar *et al*. (2016) and El-Bana *et al*. (2020).**

Conclusion

Dealing with the data presented in this study it can be recommended to increase the cultivated area of the varieties Super 301 and Shakha109 as recent varieties compared by Shakha102 as ancient variety since it has the best physical, chemical, and nutritional properties and it was the highest acceptable organoleptically upon subjection cooking. In addition, new varieties of rice (Super 301 and Shakha109) are characterized by high production and tolerate drought and salinity, Due to the lack of fresh water available for cultivation and the possibility of using seawater for cultivation.

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الملخص العربي

الخصائص الطبيعية الكيميائية وجودة الطهي لأصناف الأرز المصري الحديثة

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يعتبر الأرز (*Oryza sativa* L.) ثاني أهم محصول حبوب والمصدر الأساسي للتغذية لنصف سكان العالم. تم تقدير الخواص الفيزيائية والكيميائية والقيمة الغذائية وجودة الضرب والتبيض والخصائص الحسية لأصناف الأرز المصري (البني والأبيض) وهي سوبر 301، سخا 109، سخا 102. واظهرت النتائج ان حبوب الارز للصنف سخا 102 هي أكثر الاصناف في الطول واقل الاصناف في العرض، من ناحية اخرى فإن الماء الممتص اثناء الطهي للأرز الابيض كانت اعلى منها في الارز المقشور وان الارز البنى للصنف سخا 109 استغرق اطول فترة للطهي حوالي 41 دقيقة مقارنة بباقي الاصناف. أظهر الصنف سوبر301 أعلى درجة تكوين الجل وكذلك درجة حرارة الجلتنة واستطالة الحبوب بين كل الأصناف. كما اظهرت النتائج ان الارز المقشور لكل الاصناف احتوى على نسب اعلى من البروتين الخام والمستخلص الايثيرى والرماد والالياف الخام و نسبة اقل من الكربوهيدرات مقارنة بالأرز الابيض. كما احتوى الارز سوبر301 على اعلى نسبة من المعادن للأرز البني والأبيض مقارنة بباقي الاصناف. في النهاية، يمكن التوصية بزيادة المساحة المزروعة لأصناف سوبر 301 وسخا 109 كأصناف حديثة نظرًا لأنها تتمتع بأفضل الخواص الفيزيائية والكيميائية والغذائية وذات خصائص حسية مقبولة عند الطهي.

الكلمات الإسترشادية: الصفات الفيزيائية والكيميائية، جودة الطبخ، الأرز البني والأبيض.

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