Effect of Parboiling and Storage Periods on Grain Quality Characters of G179 Rice Cultivar

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ABSTRACT

This study was conducted at Rice Technology and Training Center (RTTC) Alexandria during 2014/2015 seasons. The main objectives of present study were to determine the effect of parboiling and storage periods on grain quality characters of Giza 179 rice cultivar during 2014 and 2015 rice growing seasons. Fresh harvested paddy was adjusted to 14% moisture content and then parboiled to evaluate the effect of parboiling. After parboiling the samples were stored for three storage period, i.e. 3, 6 and 9 months to investigate the effect of storage conditions on the parboiled rice. The results indicated significant differences for most studied characters during both study seasons. Storage for nine months gave the highest values for hulling %, milling %, broken %, water uptake, cooking time, protein amylase and elongation during both study seasons. While, the highest values for 1000 grain weight, hardness, gel consistency and gelatinization temperature were noticed for control during both seasons.

Key words: Oryza sativa L.; Grain quality; parboiling; storage

INTRODUCTION

Egypt produces yearly about 6 million tons of paddy. This production is seasonal while consumption is continuous throughout the year. Suitable storage conditions must be provided for the paddy after harvest until it is needed for consumption. During storage Physico-chemical properties of paddy keep changing and degree of changes vary depending on storage condition prevail.

Giza 179 is newly released rice cultivar in Egypt. This cultivar possess high yielding ability besides resistance to blast disease, the most distractive disease attacks rice in Egypt, tolerant to some abaiotic stress (salinity and drought). This cultivar however has a defect in its milling characters. The broken percentage reaches more than 10% which reduces commercial value. Effort has been done to overcome this problem through breeding program and/or some agronomy practices. One of these practices is parboiling.

It is though that parboiling come into use merely to facilitate the removal of the husk from paddy and to minimize its breakage during milling. From the nutritional point of view, parboiling fills the void spaces and cements the cracks inside the endosperm making the grain hoarder and minimizing internal fissuring and thereby breakage during milling (corren *et al*.,2006). The market value of milled rice as a product depends largely on physical qualities after the processing. The milling of parboiled rice presents has difficulty because the loss of nutrient during polishing at a less rapid rate than in the case if raw rice. It should be noted, however, that parboiled rice will also suffer loss of nutrient if the polishing is carried out too far.

The important of parboiling rice has pronounced in many developing countries as a means for reducing post harvest losses. Parboiling is a hydrothermic process in which rough rice is steeped in water, steamed and dried. The main change brought by this treatment to rice is gelatinization of starch and disintegration of the protein bodies in the endosperm, which expand and fill the interanular spaces enchased by polygonal starch granules. This process imports hardness to the rice and then parboiled rice exhibits less breakage during milling.

Accordingly, the present study aimed to study the effect of parboiling on grain quality character especially milling character and the effect of storage period of parboiled grain on the Physico-chemical characters of Giza 179 cultivar.

MATERIALS AND METHODS

Certified seeds of Giza 179 cultivar were provided by the Rice Research Section, Field Crops Research Institute, Agriculture Research center, Sakha, Kafr El Sheikh, Egypt during 2014 and 2015 rice growing seasons. The grain quality characters and parboling process were done and tested at the laboratories Rice Technology Training Center (RTTC) Alexandria Egypt.

The paddy was mechanically cleaned and impurities were removed based on shape, size and specific weight and then packed in jut sacks and then parboiled paddy were stored immediately after parboiling at room temperature (15 c^o - 27 c^o) and RH 63%:84% for 9 months such conditions. The storage periods were 3 ,6 and 9 months.

Parboiling process using steam (German method)

A control sample (Zero time storage) was analyzed after the processing and dried (13.5 %) Schule process. The peculiarity of this system is that steam is not directly applied to the paddy but is only used to heat the

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water. The paddy is put into a pressure tank and is first soaked for about 120 minutes in medium temperature water kept in circulation. When the rice has reached the temperature of the soaking water the water supply off and Hydrostatic pressure of 4 to 6 kg/cm is applied by admitting compressed air. The second heating or cooking period starts by lowering and readmitting water heated to a very high temperature to ensure that the starch gelatinizes completely. The water is then drained away and the paddy with a moisture content of about to 30 – 35 percent (w.b.) (Kimura,et al,.1976 and Bhattachorya 1985) drying is continued until a moisture content of 13 percent is reached at room temperature.

Studied characters:

1- moisture content
The moisture content of paddy sample was determined using a sample of 20 grams whole paddy grains after being placed in forced convection oven set (model ws-3), at 130 c for16 hours (Mathews 1962

2- Head rice yield
Paddy (250 g) husked through a satake roll huller (Model HU35 A.Japan) after that the kernels were Polished using a Satake rice polisher (Model TM05, Japan).

3- Thousand grain weight
For the one thousand grain test, the granometer Satake grain counter (Model Ky-130, Japan) was used to randomly count the required numbers. The value as a average of five replicates were recorded.

4- Dimensions
TheDimensions of paddy grains (length,thickness, and width) were measured by Satake shep tester (Model MK-200, Japan) with range 0 – 20 m m and accuracy 0.01m m.(khush *et al* .,1979).

5- Hardness
Grain hardness was measured using grain hardness tester for each rice sample 10 grains were tested. (Islam *et al* 2001)

6- Amylose
Amylose content was estimated by the simplify procedure by Juliano, 1971

7- Gel consistency
Gel consistency was determined by procedure described by (Cagampang *et* al.,1973)

8- Gelatinization temperature
Gelatinization temperature was recorded according to (little *et al*., 1958).

9- Protein
Protein content was determined for brown rice, according to standard Micro-Kjeldahl method. Then the estimated nitrogen content was multiplied by a factor of 5.95 to estimate the crude protein content.

10- Water up take
Water up take at 77c was determined for milled rice sample as described by (Simpson et al.,1965).

11- Elongation
Elongation ratio was calculated according to (Azeez and Shafi.,!966)

The samples were arranged in a randomized complete block design with ٣ replicates. Analysis of variance were estimated according to Gomez and Gomez (1984) using SAS program,version 8.0.

RESULTS AND DISCUSSION

I. The effect of parboiling on the Physico-chemical characters of Giza 179 cultivar

Studies	Before parboiling		After parboiling (control)	
character	**2014**	**2015**	**2014**	**2015**
Hulling %	79.67	79.11	79.25	79.22
Milling %	69.79	69.88	70.05	70.00
Broken %	7.91	7.95	1.88	1.84
Grain length (m.m)	5.66	5.78	5.73	5.80
Grain width (m.m)	2.72	2.81	2.71	2.82
Grain thickness (m.m)	1.99	2.17	2.18	2.22
Grain shape (L/W)	2.08	2.05	2.12	2.06
1000 grain (gm)	22.84	22.98	22.87	23.00
Hardness (Kg/cm)	5.22	4.99	9.13	9.20
water up take(ml/100gm)	460.1	466.2	476.33	475.67
cooking time (min)	20.00	21.67	23.00	23.07
Protein content (%)	8.63	8.38	8.91	8.80
Amylose content (%)	19.09	19.14	19.14	19.15
Elongation (%)	57.12	54.87	58.71	55.42
gel consistency (G.c)(mm)	92.88	90.98	91.52	91.84
Gelatinization temperature (G.T.) Spreading	4.89	4.73	4.82	4.78
Clearing	4.19	4.01	4.59	4.62

II. The effect of storage period subjected to parboiling

Table (1) showed that milling characters were significantly effected by parboiling and storage periods during both seasons. Data indicated that the highest values for hulling % (79.25 and 79.22%) were noticed with control in 2014 and 2015 seasons respectively. Moreover, The highest values for milling % (70.12 and 70.06 %) were recognized with storage for 9 months in 2014 and 2015 seasons respectively. Furthermore, data declared that the highest broken % in 2014 and 2015seasons were 2.16 and 2.10 % respectively. These results were in harmony with those reported by El Akary *et.al*.(1997).

Data in table (2) represent effect of parboiling and storage periods of Giza 179 rice cultivar during 2014 and 2015 seasons. Data in table 2, showed that storage periods doesn't effect on grain dimensions characters during both study seasons .These results were in harmony with Fofana *et.al*., 2011

Data in table (3) revealed significant differences between studied characters as effected by storage periods during both study seasons. The highest values for 1000 grain weight (22.87 and 23.00 gm) were noticed with control in 2014 and 2015 seasons, respectively This might be due to increase storage period the moisture content % decrease so % of 1000 grain weight grain weight. These results were in harmony with Islam *et. al*., 2001 and Bello et.al., 2006.

Moreover, data indicated that the highest values for hardness (9.13 and 9.20 kg/cm) were noticed with control in 2014 and 2015, respectively. This results were in agreement with Juliano 1985, Banjong 1986, and bocevska et.al., 2009.

Furthermore,data in table (3) revealed that increasing storge perieds significantly icreased cooking time and water up take during both study seasons . The highest values for both characters were noticed by storage for 9 month during both study seasons. The highest values for cooking time were 23.84 and 23.800 min while values for water up take were 485.33 and 58 ml/100 gm milld rice grains in 2014 and 2015 respectivety. These results were in agreement with Singh *et.al*. 2005.

In addition data in table (4) revealed that storage for 9 months significantly increased portein content %, Amylose % and Elongations % during both study seasons. These results were in harmony with Elakary *et.al*., 1997. The highest values for protein % were 9.02 and 8.99 % in 2014 and 2015 seasons respctively. Moreover the highest values for Amylose % were 20.03 and 19.92% while for elongation the highest values were 59.37 and 59.40% in 2014 and 2015 seasons respctively.These results were in harmony with Hermansson and Svegmork 1996.and Juliano., *et. al*.,1981.

Table 1. Effect of storage periods and parboiled grains of Giza 179 rice cultivar on hulling, milling and Broken characteristics daring 2014 and 2015 seasons

Treatment / Storage period	Hulling (%)		Milling (%)		Broken (%)	
	2014	2015	2014	2015	2014	2015
Control	79.25	79.22	70.05	70.00	1.88	1.84
3	79.41	79.38	69.90	69.83	1.90	1.85
6	79.59	79.66	69.97	69.90	2.02	2.07
9	80.06	80.13	70.12	70.06	2.16	2.10
L.S.D.	0.151	0.127	0.051	0.032	0.102	0.115

Table 2. Effect of storage periods and parboiled grains of Giza 179 rice cultivar on grain dimensions characteristics during 2014 and 2015 seasons

Treatment / Storage period	Grain length (mm)		Grain width (mm)		Grain thickness (mm		Grain shape (L/W)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	5.73	5.80	2.71	2.82	2.18	2.22	2.12	2.06
3	5.74	5.70	2.78	2.70	2.21	2.19	2.06	2.11
6	5.81	5.74	2.84	2.82	2.22	2.27	2.04	2.03
9	5.76	5.79	2.88	2.83	2.25	2.29	2.00	2.04
L.S.D.	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

Table 3. Effect of storage periods and parboiled grains of Giza 179 rice cultivar on 1000 grain, hardness, water up take and cooking time characteristics during 2014 and 2015 seasons

Treatment / Storage period	1000 grain (gm)		Hardness (Kg/cm)		water up take (ml/100gm)		cooking time (min)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	22.87	23.00	9.13	9.20	476.33	475.67	23.00	23.07
3	22.84	22.69	8.82	9.00	479.67	479.67	23.17	23.14
6	22.65	22.66	9.00	9.06	483.00	482.33	23.48	23.50
9	22.44	22.50	8.80	8.82	485.33	485.00	23.84	23.80
L.S.D.	0.030	0.0112	0.153	0.0122	1.356	2.725	0.164	0.055

Table 4. Effect of storage periods and parboiled grains of Giza 179 rice cultivar on grain Protein, Amylose and Elongation characteristics during 2014 and 2015 seasons

Treatment / Storage period	Protein content (%)		Amylosecontent (%)		Elongation (%)	
	2014	2015	2014	2015	2014	2015
Control	8.91	8.80	19.14	19.15	58.71	55.42
3	8.88	8.74	19.62	19.60	58.53	58.92
6	8.86	8.76	19.86	19.92	59.13	59.02
9	9.02	8.99	20.03	20.82	59.37	59.40
L.S.D.	0.015	0.020	0.155	0.432	0.172	0.351

Table 5. Effect of storage periods and parboiled grains of Giza 179 rice cultivar on grain gel consistency and gelatinization temperature characteristics during 2014 and 2015 seasons

Treatment / Storage period	gel consistency (G.c) (mm)		gelatinization temperature (G.t)			
			spreading		clearing	
	2014	2015	2014	2015	2014	2015
Control	91.52	91.84	4.82	4.78	4.59	4.62
3	91.02	90.98	4.73	4.64	4.45	4.43
6	90.46	90.40	4.54	4.55	4.40	4.39
9	90.06	90.03	4.06	4.04	4.23	4.26
L.S.D.	0.339	0.481	0.082	0.134	0.042	0.033

Further data in table (5) indicated that Gel consistency and gelatinization temperature showed the highest values with control during 2014 and 2015 seasons. The highest values for Gel consistency were 91.52 and 91.4 mm in 2014 and 2015 seasons respectively. These results were in harmony with Cagampang *et.al*. 1973. Moreover the highest values for Spreading 4.82 and 4.78 while the highest values for Clearing were 4.59 and 4.62 in 2014 and 2015 seasons respectively. These results were in agreement with Yehand li., 1996 and Wang and Sastry 1997.

CONCLUSION

Finally, it can be concluded that grain quality characteristics of Giza 179 cultivar were affected by parboiling, and the parboiled grain were significantly affected by storage period. Nine months' storage gives the highest values for hulling %, milling %, broken %, water uptake, cooking time, protein amylase and elongation during both study seasons. While, the highest values for 1000 grain weight, hardness, gel consistency and gelatinization temperature were noticed with control during both seasons.

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الملخص العربي

تأثير الغلى وفترات التخزين على جودة حبوب الأرز فى الصنف جيزة ١٧٩

مدحت عبد المنعم الدليل

أجريت هذه الدراسة فى مركز تدريب تكنولوجيا الأرز خلال الموسمين ٢٠١٤– ٢٠١٥. وتوضح الدراسة تأثير عملية الغلى وفترات التخزين على خواص جودة الحبوب لصنف الارز جيزة ١٧٩ خلال الموسمين ٢٠١٤–٢٠١٥ .تمت عملية الغلى للارز على درجة رطوبة ١٤% لتحديد تأثير عملية الغلى. بعد غلى العينات تم التخزين على فترات ٣شهور، ٦ شهور و٩ شهور لمعرفة تاثير التخزين على خواص الأرز المغلى. أوضحت النتائج وجود اختلافات معنوية فى العديد من الصفات المدروسة خلال موسمى الدراسة. أعطت فترة التخزين لمدة ٩ شهور أعلى قيمة بالنسبة لصفات النسبة المئوية للتصافى، النسبة المئوية للتبييض، النسبة المئوية للكسر، درجة امتصاص الماء، وقت الطهى، نسبة البروتين، الأميلوز، ودرجة الاستطالة خلال موسمى الدراسة.بينما الصفات وزن ١٠٠٠ حبة ،درجة الصلابة، كثافة الجيل، درجة حرارة الجلتنة تشابهت مع الكنترول خلال موسمى الدراسة.