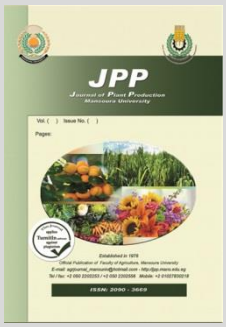
Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Influence of some Storage Conditions on Grain Quality Characters of some Egyptian Rice Cultivars

Abd El Salam, Kh. M. H.*; G. M. Abou El-Soud and A.M. Marei

Rice Technology Training Center (RTTC), Field Crops Research Institute, Agricultural Research Center, Alexandria, Egypt



ABSTRACT

Two experiments were performed at Rice Technology Training Center (RTTC, Alexandria), Field crop Research Institute, Agricultural Research Center (ARC) , Egypt, to decide the impact of storage periods (3, 6, 9 and 12 months), type of bags (jute, paper, stripped plastic and polyethylene) and their interaction on grain quality characters of rice cultivars. Newly harvested certified seeds in 2018 and 2019 seasons of three rice cultivars namely, Sakha 101 as japonica cultivars, Giza 178 as indica/ japonica cultivars, and Egyptian Yasmin as indica cultivars were provided by Rice Research Program, Agriculture Research Center, Sakha, Kafr El-Sheikh, Egypt. A split- split plot design with three replicates was used. The most noteworthy qualities for hulling % and milling % by keeping Sakha 101 for 3 months in jute bags in both seasons. Furthermore, data revealed that keeping Egyptian Yasmin for year in polyethylene bags showed predominance values for broken %, amylose content % and protein content % in both study seasons. Most elevated values for elongation % and water uptake were realized by keeping Egyptian Yasmin for year in jute bags in both seasons. Most elevated values for gel consistency were recorded by keeping Sakha 101 for year in jute bags while; the most noteworthy values for spreading and clearing were realized by keeping Sakha 101 for 3 months in polyethylene bags in both seasons. We recommend to store paddy rice in jute bags for getting best quality characteristics for rice.

Keywords: rice, storage, grain quality, storage bags

INTRODUCTION

Storage of rice is very important in Egypt because it is annual crop and is consumed during the same year. Hence, Appropriate storage conditions should be accommodated for paddy rice after harvest until it is required for utilization. Chao (2001) decided the distinctions in supplement quality for seven cultivars by storage for eight months at room temperature and means of amy1ose content of new (19.7%) and stored rice was (19.4%) and means of protein of new (6.4%) and stored rice was (6.2 %). El Hissewy *et al.* (2002) showed that kernel elongation and water absorption were elevated by prolong the storage periods while, gel consistency diminished as storage period was proceeded and keeping rice in jute sacks for 9 months is the most optimum condition to maintain the cooking and eating quality.

Khattab (2007) uncovered that Sakha 104, Egyptian Yasmin and Giza 177 contrasted fundamentally in milling characters as impacted by storage periods. Also, debasement pattern in milling characters was realized when storage periods was expanded over a half year and boosted following a year. Clearly, it tends to be notice that increasing storage periods for over a half year, hulling (%) and milling (%) were diminished while, broken (%) increment. All cooking and eating quality characters were impacted altogether by assortments and different storage periods. Kernel elongation, amylose content (%) and cooking time values were increased, but gel consistency diminished.

Mahmoud *et al.* (2008) found that the hybrid rice showed a protein content of 12.4%, which was 28 and 18.2% higher than those of nivara and IR 64, respectively thus the increment in protein content was reliant upon the hereditary foundation of the rice assortment utilized in the hybridization. Increasing temperature influences different milling quality attributes of the paddy such as chalkiness, immature grains, grain dimensions, fissuring, protein content, amylose content and length of amylopectin chain (Wassmann *et al*., 2009).

Abd El Bary (2012) illustrated that storage of paddy rice for one year prior to milling brought about critical reduction in the percent of bran of the thirteen rice varieties, and it went somewhere in the range of 18.77% and 8.13% in storage rice. Sakha 102 showed the most elevated decline in bran because of storage (12.84%), while Giza 171 showed the least decline (0.91%). El Kady *et al.* (2013) detailed that milling characters, degree of milling, cracks percentage, and 1000-paddy grain weight were fundamentally impacted by storage periods. Besides, expanding storage period for over a half year enhance all chemical composition of the rice grain, except for ash content, while fiber content diminished. storage place didn't influence grain dimensions, amylose content, gelatinization temperature, gel consistency and milling characters, while head rice percentage, degree of milling, 1000-paddy grain weight and cracks percentage were significantly impacted. Decreasing head rice yield and increment broken rice yield are the adverse impact of high temperatures in terms of milling quality (Lyman *et al*., 2013).

El Dalil (2017) mentioned that storage Giza 179 for 9 months gives the most noteworthy qualities hulling %, milling %, broken %, water uptake, cooking time, protein, amylose and elongation during both study seasons. Wanthi *et al.* (2017) resulted that head rice yield, broken rice yield and degree of milling were estimated initially and after a half year. Result revealed that head rice yield of paddy diminished by 2.1-3.5% with elevation in temperature from 26°C to 38°C after half year. This study intended to explore the performance of some rice cultivars such as Sakha 101, Giza 178, and Egyptian yasmine

* **Corresponding author.**
E-mail address: khaledabdelsalam@hotmail.com
DOI: 10.21608/jpp.2022.160818.1167

under various storage periods (3, 6, 9 and 12 months) by using four distinct kinds of sacks (jute, paper stripped plastic and polyethylene). To accomplish such objective, the impact of storage period and various kinds of sacks on milling and cooking and eating quality of rice were tested.

MATERIALS AND METHODS

Two experiments at Rice Technology Training Center (RTTC), Alexandria, Egypt, were performed to detect the influence of storage periods, types of bags and their interaction on quality characters of rice cultivars. Newly harvested certified seeds in 2018 and 2019 growing seasons (provided by Rice Research Program, Agriculture Research Center, Sakha, Kafr El-Sheikh, Egypt) for three rice cultivars namely, Sakha 101 (japonica), Giza 178 (indica/ japonica, and Egyptian Yasmin (indica cultivars) A split- split plot design with three replicates was used. The main plots were committed to rice cultivars and the sub plots were involved by various storage periods (3 months, 6, 9 and 12 months) though, the sub sub plots were devoted to four distinct kinds of bags (jute, paper stripped plastic and polyethylene). Newly harvested paddy rice grains (10 Kg of paddy rice) stored in well aerated warehouse at 14% moisture content of three rice cultivars and all precautions were paid to protect the stored samples from rodents, birds and / or insects attack under this study in the two seasons. Average monthly temperature and humidity during experimental seasons 2018/2019 and 2019/2020 are illustrated in Figures 1 and 2. While, the variation of milling and some cooking and eating quality characters for Sakha 101, Giza 178 and Egyptian yasmine is presented in Table (1).

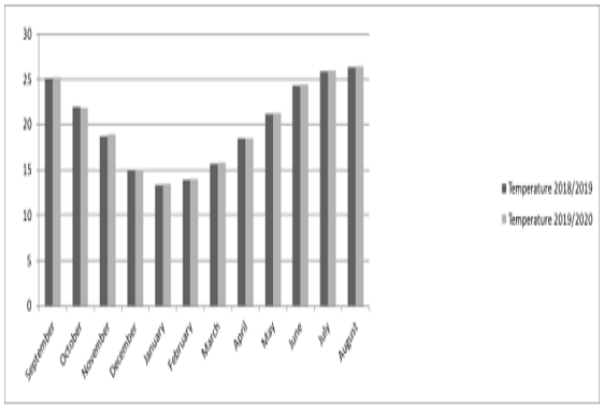


Figure 1. Average temperature for both study seasons

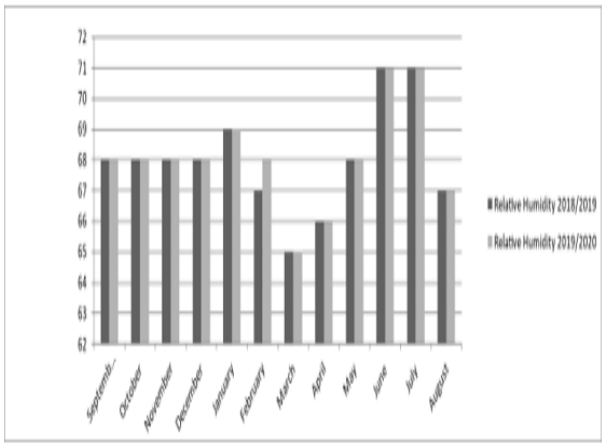


Figure 2. Average relative humidity for both study seasons

Table 1. Milling and some cooking and eating quality characters for Sakha 101, Giza 178 and Egyptian Yasmin rice cultivars (zero-time storage) during 2018 and 2019 harvested Seasons.

Characters	Cultivars					
	Sakha 101		Giza 178		Egyptian Yasmin	
	2018	2019	2018	2019	2018	2019
Hulling %	81.87	81.69	79.61	79.40	77.65	77.49
Milling %	71.68	71.40	69.35	69.10	68.12	67.73
Broken %	5.66	6.13	8.38	8.11	8.45	8.86
Amylose %	17.89	18.13	18.91	19.00	22.35	22.50
Protein %	7.90	8.06	7.92	8.10	8.48	8.31
Elongation %	56.12	55.10	59.10	60.15	61.50	60.10
Water uptake (ml/100 gm milled)	430.8	432.3	438.2	440.1	448.6	447.1
Gel consistency (mm)	92.10	90.80	90.20	89.10	86.25	86.71
Spreading	5.77	5.94	4.52	4.87	2.86	2.61
Clearing	6.15	6.04	3.81	3.56	2.53	2.29

Rice samples (150 g for each) were taken haphazardly; samples were cleaned by Dockage Analyzer Machine (Carter Day CO, style number XT3, USA) to eliminate unfamiliar matter, mud balls, and immature green automatically and dehulled with an experimental Satake huller machine and polished in Satake miller and estimated according to IRRI (1996). Amylose content was assessed by the improved methodology announced by Juliano (1971), gel consistency was estimated by Cagampang *et al* (1973) and Gelatinization temperature was recorded according to little *et al*. (1958). Protein content was estimated for brown rice, according to the standard Micro – Kjeldahl methodology. Then, the assessed nitrogen content was multiplied by a factor of 5.95 to estimate the crude protein content. The water uptake at 77 º c was assessed for milled rice samples, as described by Simpson *et al.* (1965). Elongation ratio was estimated, according to Azeez and Shafi (1966). Analysis of variance was carried out according to Gomez and Gomez (1984) using SAS program, version 8 Means were compared using least significant differences (LSD) at 0.05 level of probability.

RESULTS AND DISCUSSION

Data of the main effects only of the studied factors will be introduced and examined when the interaction is not significant. Information in tables (2, 3, 4 and 5) showed tremendous contrasts for interaction between rice cultivars, storage periods and kinds of bags for all studied characters in both study seasons. Data in Table (2) revealed that the most elevated values for hulling % (81.63 and 81.45 %), milling % (71.52 and 71.24 %), were indicated by keeping Sakha 101 as japonica cultivar for 3 months in jute bags in 2018 and 2019 seasons, respectively. This might be due to optimum moisture content (13.5-14%) due to pores in jute bags that permit gas exchange. Nonetheless, the least hulling % (75.40 and 75.11 %) and milling % (65.38 and 65.12 %) were noticed with Egyptian Yasmin as indica cultivar after storage for year in polyethylene bags in both review seasons, respectively and this might be due to elevation of moisture content due to collection of water vapor on surface of rice grains that results from respiration of rice grains as polyethylene sacks contains very tight pores that doesn't permit gas exchange. These outcomes were as one with those revealed by (Khattab 2007, El Kady *et al*., 2013 and Lyman *et al*., 2013).

Moreover, values of table (2) showed that putting away Egyptian Yasmin as indica for a year in polyethylene packs showed superiority values for broken % (13.87 and 14.85 %) in both seasons, respectively and this may be because of increment moisture content due to collection of water vapor on surface of rice grains that outcomes from respiration of rice grains as polyethylene bags contains extremely limited pores that doesn't permit gas exchange and furthermore Egyptian Yasmin as indica cultivar is long grain cultivar that characterized by higher broken %. While, the most reduced values for broken % (5.83 and 6.37 %) were indicated by putting away Sakha 101 as japonica cultivar for 3 months in jute bags and this may be because of pores in jute bags that permit gas exchange and prevent formation water vapor layer on surface of rice grains or may be because of equilibrium in moisture content inside rice grains that gave least broken % in both seasons and furthermore Sakha 101 cultivar describe by lower broken % as its one of its actual characters. These outcomes were as one with those revealed by (Khattab 2007, El Kady *et al*., 2013, Lyman *et al*., 2013 and El Dalil 2017).

Table 2. Mean values for hulling (%), milling (%) and broken (%)as affected by the interaction between cultivars, storage periods and types of storage sacks in 2018 and 2019 harvested seasons.

Cultivars	Storage period	Types of storage sacks	Hulling %		Milling %		Broken %	
			2018	2019	2018	2019	2018	2019
Sakha 101	3 months	Jute	81.63	81.45	71.52	71.24	5.83	6.37
		Paper	81.39	81.23	71.28	70.93	6.40	6.72
		Stripped plastic	81.22	80.94	71.12	70.56	6.72	7.33
		Polyethylene	81.13	80.72	70.93	70.28	6.81	7.56
	6 months	Jute	81.07	80.60	71.25	70.81	6.24	7.13
		Paper	80.45	80.46	71.04	70.47	6.82	7.52
		Stripped plastic	80.42	80.23	70.92	70.22	7.15	8.03
		Polyethylene	80.31	80.05	70.75	69.92	7.38	7.84
	9 months	Jute	80.65	80.32	70.78	69.87	6.92	8.36
		Paper	80.40	80.11	70.65	69.60	7.56	8.65
		Stripped plastic	80.21	79.87	70.33	69.33	8.03	8.95
		Polyethylene	79.83	79.54	70.10	69.10	8.22	9.21
	12 months	Jute	79.75	79.51	69.82	69.21	7.86	9.05
		Paper	79.53	79.33	69.50	68.95	8.50	9.26
		Stripped plastic	79.30	79.07	69.24	68.57	9.13	9.73
		polyethylene	79.12	78.86	68.81	68.36	9.48	10.36
Giza 178	3 months	Jute	79.52	79.26	69.20	68.91	8.50	8.26
		Paper	79.30	79.03	68.93	68.65	8.83	8.59
		Stripped plastic	79.08	78.85	68.70	68.52	9.26	9.50
		polyethylene	78.86	78.60	68.52	68.39	9.33	9.66
	6 months	Jute	79.10	78.74	68.85	68.44	9.32	9.60
		Paper	78.55	78.31	68.66	68.25	9.63	9.88
		Stripped plastic	78.30	78.05	68.51	68.06	9.87	10.17
		polyethylene	78.13	77.91	68.37	67.88	9.98	10.35
	9 months	Jute	78.84	78.45	68.29	67.90	9.60	9.92
		Paper	78.60	78.26	68.13	67.69	9.86	10.11
		Stripped plastic	78.43	77.93	67.88	67.50	10.15	10.42
		polyethylene	78.25	77.71	67.65	67.27	10.32	10.67
	12 months	Jute	78.22	77.89	67.90	67.52	9.88	10.33
		Paper	77.90	77.65	67.73	67.35	10.21	10.59
		Stripped plastic	77.56	77.30	67.56	67.18	10.57	11.05
		polyethylene	77.31	77.07	67.32	67.05	10.89	11.52
Egyptian Yasmin	3 months	Jute	77.48	77.23	67.92	67.40	8.96	9.22
		Paper	77.25	77.05	67.66	67.22	9.15	9.43
		Stripped plastic	76.81	76.62	67.39	66.91	9.44	9.62
		polyethylene	76.62	76.39	67.17	66.69	9.87	9.89
	6 months	Jute	77.12	76.80	67.28	66.87	9.52	10.50
		Paper	76.85	76.51	66.85	66.50	10.77	11.54
		Stripped plastic	76.59	76.29	66.56	66.29	10.96	11.86
		polyethylene	76.38	76.12	66.35	66.13	11.36	12.32
	9 months	Jute	76.87	76.22	66.76	66.36	11.17	11.50
		Paper	76.49	75.89	66.45	66.15	11.95	12.26
		Stripped plastic	76.25	75.70	66.27	65.92	12.31	12.82
		polyethylene	76.04	75.53	66.11	65.70	12.53	13.55
	12 months	Jute	76.25	75.88	66.20	65.89	11.61	12.21
		Paper	75.90	75.62	65.84	65.60	12.32	13.05
		Stripped plastic	75.63	75.34	65.53	65.36	13.50	13.92
		polyethylene	75.40	75.11	65.38	65.12	13.87	14.85
L.S.D $_{0.05}$			0.044	0.025	0.061	0.036	0.082	0.050

Table (3) revealed that Egyptian Yasmin rice cultivar showed the most elevated values for amylose % (23.75 and 23.96 %) because of keeping in polyethylene bags for a year in both seasons, respectively and this may be because of that amylose is hereditary character, yet it's impacted by natural circumstances as (storage period, temperature, relative

humidity, and moisture content) by restricting rate. These natural circumstances increment enzymatic activity that analyze starch (amylose and amylopectin) because of ideal circumstances for these enzymes. Nonetheless, the most minimal values for amylose % (18.36 and 18.50 %) were allocated with Sakha 101 that put away in jute sacks for 3 months in the two seasons and this may be because of ideal moisture content that stabilize enzyme that analyze starch. These results were in harmony with those reported by (Khattab 2007, Wassmann *et al*., 2009 and El Dalil 2017).

Additionally, in table (3) mentioned that storing Egyptian Yasmin as indica for a year in polyethylene bags showed superior values for protein % (9.89 and 9.67 %) in both seasons, respectively and this might be due to breakage bond between starch and protein due to action of starch and protein analysis enzyme due to ideal conditions of enzymatic activity (amylase and protease enzymes) and also one of distinctive characters of Egyptian Yasmin is higher protein % as its consider long grain rice cultivar. While lowest values for protein % (8.13 and 8.21 %) were indicated by storing Sakha 101 for 3 months in jute sacks in both seasons, respectively and this might be due to inhibition of enzymatic activity for breakage bond between starch and protein due to improper conditions as temperature and relative humidity and moisture content inside rice grains. These outcomes were as one with those announced by (Khattab 2007, Wassmann *et al*., 2009 and El Dalil 2017).

Table 3. Mean values for amylose (%) and protein (%)as affected by the interaction between rice cultivars, storage periods and types of storage sacks in harvested 2018 and 2019 seasons.

Cultivars	Storage period	Types of storage sacks	Amylose %		Protein %	
			2018	2019	2018	2019
Sakha 101	3 months	Jute	18.36	18.50	8.13	8.21
		Paper	18.50	18.71	8.19	8.27
		Stripped plastic	18.67	18.78	8.25	8.33
		polyethylene	18.72	18.89	8.32	8.45
	6 months	Jute	18.51	18.65	8.26	8.35
		Paper	18.62	18.83	8.39	8.43
		Stripped plastic	18.76	18.92	8.44	8.55
		polyethylene	18.83	19.02	8.52	8.72
	9 months	Jute	18.72	18.88	8.34	8.51
		Paper	18.86	19.01	8.52	8.70
		Stripped plastic	18.93	19.13	8.75	8.93
		polyethylene	19.08	19.22	8.93	9.08
	12 months	Jute	19.03	19.21	8.65	8.86
		Paper	19.14	19.32	8.79	9.05
		Stripped plastic	19.20	19.43	8.96	9.17
		polyethylene	19.26	19.55	9.07	9.28
Giza 178	3 months	Jute	19.11	19.33	8.20	8.42
		Paper	19.26	19.54	8.39	8.59
		Stripped plastic	19.37	19.60	8.52	8.67
		polyethylene	19.43	19.69	8.59	8.78
	6 months	Jute	19.25	19.48	8.45	8.60
		Paper	19.37	19.65	8.60	8.82
		Stripped plastic	19.52	19.72	8.73	8.98
		polyethylene	19.58	19.90	8.80	9.07
	9 months	Jute	19.39	19.59	8.66	8.91
		Paper	19.55	19.77	8.81	9.09
		Stripped plastic	19.60	19.89	9.06	9.24
		polyethylene	19.64	19.94	9.17	9.31
	12 months	Jute	19.60	19.72	8.83	9.12
		Paper	19.72	19.85	8.97	9.22
		Stripped plastic	19.85	19.98	9.11	9.37
		polyethylene	19.94	20.12	9.26	9.58
Egyptian Yasmin	3 months	Jute	22.56	22.65	8.63	8.50
		Paper	22.75	22.93	8.78	8.69
		Stripped plastic	22.89	23.13	8.90	8.75
		polyethylene	22.95	23.20	8.95	8.82
	6 months	Jute	22.90	23.22	8.90	8.66
		Paper	23.17	23.30	9.17	8.75
		Stripped plastic	23.38	23.56	9.25	8.93
		polyethylene	23.21	23.62	9.30	9.10
	9 months	Jute	23.32	23.50	9.39	8.85
		Paper	23.40	23.61	9.55	9.03
		Stripped plastic	23.63	23.70	9.62	9.18
		polyethylene	23.70	23.76	9.74	9.27
	12 months	Jute	23.50	23.65	9.56	9.11
		Paper	23.62	23.82	9.72	9.45
		Stripped plastic	23.69	23.89	9.83	9.58
		polyethylene	23.75	23.96	9.89	9.67
L.S.D $_{0.05}$			0.051	0.029	0.011	0.032

Table (4) declared that highest significant values for elongation % (64.55 and 63.89 %) and water uptake (457.6 and 455.2 ml water/100 gm milled grains) were indicated by keeping Egyptian Yasmin for 12 monts in jute bags in both study seasons, respectively and this might be due to decline in moisture content of rice grains (11 to 11.5 %) so it needs to absorb more amount of water thus cause increment in elongation and water uptake and due to increasing surface area of Egyptian Yasmin as indica cultivar exposed to absorption of water beside that Egyptian Yasmin as indica cultivar is long grain cultivar that characterize by higher elongation and water uptake. While the lowest elongation % (55.23 and 53.72 %) and water uptake (425.3- and 428.6-ml water/100 gm milled grains) were noticed by keeping Sakha 101 for 3 months in polyethylene bags in both seasons and this might be due to elevation in moisture content (15.5-16%) and decreasing surface area exposed to absorption of water and this resulted in lower elongation and water uptake in both seasons. These outcomes were in hamony with (El Hissewy *et al.*, 2002, Khattab 2007 and El Dalil 2017).

Table 4. Mean values for elongation and water uptake as affected by the interaction between rice cultivars, storage periods and types of storage sacks in harvested 2018 and 2019 seasons.

Cultivars	Storage period	Types of storage sacks	Elongation %		Water uptake ml water/100 gm milled grains)	
			2018	2019	2018	2019
Sakha 101	3 months	Jute	56.30	55.20	431.5	433.6
		Paper	56.17	54.56	430.8	432.4
		Stripped plastic	55.75	54.13	428.6	430.2
		Polyethylene	55.23	53.72	425.3	428.6
	6 months	Jute	56.68	56.12	433.7	435.2
		Paper	56.37	54.97	432.3	433.8
		Stripped plastic	56.11	54.65	430.5	432.6
		Polyethylene	55.80	54.11	428.2	431.4
	9 months	Jute	57.25	56.73	435.2	436.5
		Paper	56.72	55.82	433.8	434.9
		Stripped plastic	56.45	55.21	432.5	433.6
		Polyethylene	56.14	54.94	430.6	432.4
	12 months	Jute	57.89	57.23	436.8	437.3
		Paper	57.22	56.65	435.5	436.8
		Stripped plastic	56.90	56.18	434.2	435.8
		Polyethylene	56.43	55.60	432.7	434.2
Giza 178	3 months	Jute	59.60	60.36	440.2	442.6
		Paper	58.36	59.45	437.5	440.3
		Stripped plastic	57.45	57.93	433.2	437.6
		Polyethylene	57.12	57.62	431.5	435.2
	6 months	Jute	60.92	61.70	442.6	445.1
		Paper	59.70	60.82	439.7	443.2
		Stripped plastic	59.22	58.41	435.6	440.2
		Polyethylene	58.65	58.03	434.2	438.6
	9 months	Jute	62.33	61.97	444.8	447.3
		Paper	60.50	61.14	442.6	446.2
		Stripped plastic	59.87	58.82	440.9	443.8
		Polyethylene	59.23	58.40	438.3	440.1
	12 months	Jute	63.76	62.55	447.2	450.2
		Paper	62.41	61.70	444.8	448.3
		Stripped plastic	61.35	60.39	442.6	445.6
		Polyethylene	60.39	59.45	441.5	443.1
Egyptian Yasmin	3 months	Jute	62.87	61.65	450.3	448.3
		Paper	62.69	61.38	448.2	446.1
		Stripped plastic	62.52	60.65	447.5	445.3
		Polyethylene	61.36	60.23	443.6	441.6
	6 months	Jute	63.42	63.10	452.6	450.1
		Paper	62.86	61.87	450.8	448.5
		Stripped plastic	62.65	61.22	449.1	446.9
		Polyethylene	61.89	60.77	445.3	443.2
	9 months	Jute	63.87	63.48	454.8	453.1
		Paper	63.33	62.71	452.5	450.6
		Stripped plastic	62.94	61.95	450.9	448.2
		Polyethylene	62.21	61.39	448.2	445.9
	12 months	Jute	64.55	63.89	457.6	455.2
		Paper	63.80	63.32	455.1	452.8
		Stripped plastic	63.27	62.65	452.5	450.6
		Polyethylene	62.71	61.90	450.1	448.9
L.S.D $_{0.05}$			0.213	0.152	0.422	0.276

Values in table (5) pronounced the most elevated values for gel consistency (96.83 and 95.96 mm) were noticed by keeping Sakha 101 rice cultivar for 12 months in jute bags in both seasons and this might be due to heredity factors of

Sakha 101 rice cultivar and storage conditions. While the lowest values for such character (84.32 and 85.49 mm) were observed by storing Egyptian Yasmin rice cultivar for 3 months in polyethylene bags in both study seasons and this might be due to heredity factor of Egyptian Yasmin rice cultivar as it considers long grain cultivar. These outcomes were as one with those announced by (El Dalil 2017).

In addition, data in table (5) showed values for spreading and clearing in 2018 and 2019 seasons. There is inversely relation between scale of spreading and clearing and gelatinization temperature (G.T) and to get value of G.T we get average value of spreading and clearing.

The highest significant values for spreading (6.49 and 6.36) and clearing (6.56 and 6.39) were recorded by keeping Sakha 101 rice cultivar for 3 months in polyethylene bags in both seasons, respectively and this indicates low G.T (lower than 70 c^0) and this might be due to elevation in moisture content and direct relation with elongation and water uptake.

While the least values for spreading (2.17 and 2.03) and clearing (1.70 and 1.48) were noticed by storing Egyptian Yasmin rice cultivar for 12 months in jute bags in 2018 and 2019 seasons, respectively and this indicates high G.T (higher than 75 c^0) and this might be due to decreasing in moisture content of rice grains and due to the direct relation with elongation %, water uptake. These results were in harmony with (El Dalil 2017).

Table 5. Mean values for gel consistency (mm) and gelatinization temperature as affected by the interaction between cultivars, storage periods and types of storage sacks in harvested 2018 and 2019 seasons.

Cultivars	Storage period	Types of orage sacks	Gel consistency (G.C) mm		Gelatinization temperature (G.T)			
					Spreading		Clearing	
			2018	2019	2018	2019	2018	2019
Sakha 101	3 months	Jute	92.80	91.50	5.65	5.83	6.07	5.90
		Paper	92.12	91.03	5.86	6.04	6.18	6.05
		Stripped plastic	91.62	90.86	6.02	6.17	6.33	6.21
		Polyethylene	90.18	90.52	6.49	6.36	6.56	6.39
	6 months	Jute	93.92	92.63	5.29	5.54	5.59	5.37
		Paper	92.86	91.92	5.58	5.67	5.90	5.72
		Stripped plastic	92.35	91.32	5.75	5.90	6.11	5.91
		Polyethylene	91.11	90.97	6.26	6.14	6.22	6.16
	9 months	Jute	95.20	94.67	5.18	5.35	5.25	5.14
		Paper	93.82	94.02	5.33	5.52	5.42	5.28
		Stripped plastic	92.89	93.60	5.49	5.65	5.61	5.43
		Polyethylene	92.56	93.21	5.66	5.83	5.75	5.57
	12 months	Jute	96.83	95.96	5.06	5.17	5.08	5.02
		Paper	95.36	94.90	5.18	5.31	5.17	5.10
		Stripped plastic	94.68	94.11	5.30	5.42	5.30	5.19
		Polyethylene	93.75	93.52	5.44	5.60	5.58	5.25
Giza 178	3 months	Jute	91.80	91.23	4.39	4.78	3.62	3.43
		Paper	91.25	90.86	4.61	4.90	3.85	3.50
		Stripped plastic	90.70	90.52	4.76	5.08	4.02	3.89
		Polyethylene	90.45	90.14	5.05	5.31	4.12	4.04
	6 months	Jute	92.14	91.49	4.30	4.62	3.43	3.37
		Paper	91.92	91.30	4.55	4.76	3.70	3.43
		Stripped plastic	91.66	90.88	4.62	4.90	3.82	3.55
		Polyethylene	91.23	90.52	4.96	5.12	3.95	3.81
	9 months	Jute	92.62	92.18	4.21	4.39	3.29	3.11
		Paper	92.36	91.90	4.33	4.52	3.46	3.20
		Stripped plastic	91.90	91.69	4.55	4.73	3.61	3.36
		Polyethylene	91.59	91.15	4.73	4.95	3.77	3.50
	12 months	Jute	93.82	92.85	4.05	4.21	3.05	2.91
		Paper	93.21	92.51	4.13	4.30	3.19	3.02
		Stripped plastic	92.75	92.10	4.22	4.48	3.34	3.15
		Polyethylene	92.27	91.71	4.40	4.62	3.57	3.32
Egyptian Yasmin	3 months	Jute	87.33	87.86	2.70	2.49	2.33	2.11
		Paper	86.90	87.40	2.96	3.15	2.49	2.31
		Stripped plastic	85.60	86.32	3.12	3.38	2.65	2.49
		Polyethylene	84.32	85.49	3.29	3.56	2.82	2.67
	6 months	Jute	88.52	89.32	2.50	2.37	2.13	2.02
		Paper	88.20	88.85	2.78	2.62	2.38	2.15
		Stripped plastic	86.70	87.50	2.91	3.09	2.51	2.34
		Polyethylene	85.56	86.22	3.13	3.23	2.65	2.50
	9 months	Jute	89.45	90.22	2.32	2.12	1.95	1.76
		Paper	88.93	89.56	2.51	2.30	2.08	1.95
		Stripped plastic	87.52	88.11	2.65	2.42	2.28	2.16
		Polyethylene	86.20	87.65	2.86	2.75	2.50	2.38
	12 months	Jute	91.25	90.89	2.17	2.03	1.70	1.48
		Paper	90.31	89.97	2.32	2.16	1.96	1.72
		Stripped plastic	89.62	88.72	2.47	2.25	2.15	2.03
		Polyethylene	88.73	88.25	2.69	2.37	2.33	2.15
L.S.D $_{0.05}$			0.128	0.361	0.017	0.033	0.022	0.059

CONCLUSION

Appropriate storage conditions must be provided for the paddy after harvest until it is needed for consumption. During storage Physio-chemical properties of paddy keep changing and level of changes fluctuate depending on storage condition prevail. Under this study the ideal storage condition obtained by keeping rice in packages according to this order, first jute packages and paper packages as it gives the best quality characteristics for rice stored for a year, then the stripped plastic packages to give medium quality characteristics for rice stored for a year. Finally, we recommend in our study in the same condition that not to keep rice in polyethylene packages as it gives lowest quality characteristics.

REFERENCES

Abd El Bary, D.A.A. (2012). Qualitative and quantitative assessment for bran and bran oil of some Egyptian rice varieties, Ph. D. thesis. Public Health Sciences (Food Analysis), High Institute of Public Health, Alex., Egypt.

Azeez, M.A. and Shafi, M. (1966). Quality in Rice. Department of Agric, West Pakistan Technology Bulletin. No. 13 pp. 50.

Cagampang, G.B.,C.M. Perez and B.O. Juliano (1973). A gel consistency test for eating quality of rice.J. Sci. Food Agr. 24:1589-1594.

Chao, A.E. (2001). Comparison of nutrient quality between new and stored grains in japonica rice. International Rice Research notes.

El Dalil, M.A.E. (2017). Effect of Parboiling and storage periods on grain quality characters of G179 rice cultivar. Alexandria Science Exchange Journal, Alexandria University, Vol.38, No.3, P. 537-542.

El- Hissewy, A.A., L.F. Rizk and S.N. Abd El Rahman (2002). Effect of some storage conditions on cooking and eating quality of rice grains. The fourth international conference and exhibition for food industries- quality control, Alexandria, Egypt.

El-Kady, A.A., S.H. Abou Khadra, Nessreen N.Bassuony and H. M. Hassan (2013). Effect of storage conditions on grain quality characters of some special rice varieties. Egypt J. Plant Breed. 17 (4): 70 – 84.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. An International Rice Research Institute Book. John Willey and Sons Inc., New York, U.S.A.

International Rice research Institute (IRRI) (1996). Standard Evaluation System for Rice. IRRI,

Juliano, B.O. (1971). Asimplified assay for milled rice amylase. Cereal Sci. Today, 16, 334-338.

Khattab, A.R.I. (2007). Study on the effect of some storage conditions on the grain quality characters of rice,

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

Lyman, N. B, K.S. Jagadish, L.L. Nalley, B.L. Dixon and T.Siebenmorgen (2013). Neglecting rice milling yield and quality underestimates economic losses from high-temperature stress. PloS one, 8(8): 72157.

M.Sc. Thesis, Fac. of Agric. Al-Azhar Univ., Egypt.

Mahmoud, A.A, S. Sukumar and H.B Krishnan (2008). Interspecific rice hybrid of Oryza sativa x Oryza nivara reveals a significant increase in seed protein content. Journal of Agricultural and Food Chemistry. 56(2): 476-482.

Manila, Philippines. P52.

SAS Institute. (1999). SAS System. Version 8. Statistical Analysis System Institute, Cary, NC, USA

Siebenmorgan, T.J. and Meullenet, J.F. 2004. Rough-rice storage. In: Champagne E.T. Rice: Chemistry and Technology. 3rd edition. American Association of Cereal Chemists, Inc. St. Paul, Minnesota, U.S.A.

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

Wanthi, M.G.G.A., S.B. Navaratne , B.M.S. Jinendra and C.M. Navaratne (2017). Effect of storing time and temperature on milling quality of parboiled and raw rice of an improved IVariety, AT 362 and a traditional variety, KURULUTHUDA. Tropical Agricultural Research & Extension 20 (1 & 2).

Wassmann, R., Jagadish S.V.K., Heuer S., Ismail A. and Redona E. (2009). Climate change affecting rice production: the physiological and agronomic basis for possible adaptation strategies. Adv Agron. 101: 59–122.

تاثير بعض ظروف التخزين علي صفات جودة حبوب الأرز

خالد مصطفى حمدى عبدالسلام ، جيرمين محمد ابو السعود و عبد السلام محمود مرعي

مركز تدريب تكنولوجيا الارز، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية، اسكندرية، مصر

الملخص

أجريت هذه الدراسة بمركز تدريب تكنولوجيا الأرز (الإسكندرية) معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – مصر لدراسة تأثير فترات التخزين (3 و 6 و 9 و12 شهور) و أنواع عبوات التخزين (أجولة جوت و أكياس ورق و أكياس بلاستيك مجدول و بولي ايثيلين) و التفاعل بينهم علي صفات جودة حبوب الأرز. تم حصاد التقاوى المعتمدة في موسمي زراعة 2018 و 2019 لثلاث أصناف أرز وهي سخا 101 ، جيزة 178 والياسمين المصري من برنامج بحوث الأرز ، مركز البحوث الزراعية، سخا، كفرالشيخ، مصر.و تم إستخدام تصميم القطع المنشقة المنشقة بثلاث مكررات. أوضحت النتائج أن أعلى القيم لنسبة التقشير ونسبة الأرز الأبيض مع تخزين صنف سخا 101 لثلاثة أشهر في الجوت في موسمي الدراسة. أظهرت البيانات أن تخزين الارز الياسمين المصري لمدة 12 شهرا في البولي إيثيلين أظهرت قيما عالية للكسر في الموسمين. أظهر الأرز الياسمين المصري أعلى قيم لنسبة الأميلوز نتيجة التخزين في البولي إيثيلين لمدة 12 شهرا في الموسمين. تخزين الياسمين لمدة 12 شهرا في البولي إيثيلين أظهر قيما عالية للبروتين في الموسمين. أعلى القيم للاستطالة وامتصاص الماء من خلال تخزين الياسمين المصري لمدة 12 شهرا في الجوت في الموسمين. أعلى قيم ثبات الجل عند تخزين صنف سخا 101 لمدة 12 شهرا في الجوت في الموسمين. أعلى القيم للانتشار و الوضوح من خلال تخزين صنف سخا 101 لمدة 3 أشهر في بولي إيثيلين ، بينما أدنى القيم مع تخزين صنف الياسمين المصري لمدة 12 شهرا في الجوت في الموسمين. لذلك ينصح تحت نفس ظروف التجربة بتخزين الأرز فى أجوله جوت للحفاظ على أعلى صفات جودة للارز.