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A STUDY ON THE EFFECT OF STORAGE PERIOD AND STORAGE BAGS ON THE CHEMICAL COMPOSITION OF RICE GRAINS OF SOME EGYPTIAN RICE VARIETIES

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Abstract

This investigation was carried out at the Rice Technology and Training Center (RTTC), in cooperation with Food Technology Research Institute (FTRI) during 1999-2000 rice growing season to study the effect of storage period and type of storage bags on the chemical composition of rice grain after harvest.

Paddy of five rice varieties i.e., Giza 178, Sakha 101, Sakha 102, Giza 181 and Egyptian Yasmine were used. The chemical composition of the grain was determined after zero, 3, 6 and 9 months storage period. However, it was analyzed after one year for samples stored in jute sacks, striped plastic bags and paper bags.

The results indicated that there were significant differences between varieties in respect to all chemical composition and these differences were mainly due to the differences in the genetic constitution of these varieties. Moreover, increasing storage period more than 6 months affected significantly all the chemical composition of the rice grain except ash. Meanwhile moisture, protein, oil contents were decreased significantly. In addition, amylose content was increased significantly by increasing storage period. Meanwhile, significant differences in protein and oil contents, only, were estimated between the different storage bags. The results also indicated that the interaction between varieties and storage periods were insignificant for all studied chemical composition.

Accordingly, it could be recommended that rice grain of any of the studied varieties could be well stored till six months without any significant changes in the chemical composition of the rice grains. On the other hand paper bags or jute sacks were the best for storing rice grain.

INTRODUCTION

A suitable storage conditions must be provided for the grains after harvest until it is needed for consumption, since rice production is seasonal and consumption is continuous through the year.

Suitable storage must maintain grain quality and quantities. Rice grain goes under a series of chemical and physicochemical changes during storage, particularly in the first few months of storage after harvesting.

Pushapamma and Reddy (1979) studied the changes in the rice stored up to one year under open shed store in three agro-climatic regions. They found that inspite of the best care given, both quantitative and qualitative losses were determined for this traditional storage methods. In parallel, numerous investigators studied the effect of storage conditions on the chemical composition of rice grain. Sharp and Timme (1986) found that storage of rice at 3°C resulted in lower level of free fatty acids than storage in higher temperature, in addition sealed polyethylene bags provided the best shelf life for brown rice.

Song and Hong (1988) found that there were almost no changes in amylose and crude protein content during storage. Wang and Hsieh (1988) reported that free fatty acids were increased in parallel with the increasing of pH value with the prolonging of storage period. However no changes in the water and alkali soluble proteins content occurred during the storage period.

Dhaliwal *et al.*, (1991) showed that protein content of milled rice decreased significantly during storage of paddy, while no significant effect on crude fat content was found by storage. Yang *et al.*, (1995) indicated that total amylose content and soluble amylose content of rice starch decreased with increasing rice storage time. In Egypt, El-Kady and El-Hissewy (1999) reported that storage period and storage bags did not affect significantly amylose content.

Less information known about rice storage in Egypt. Accordingly, the present investigation aimed at studying the effect of some storage conditions of paddy rice as storage period and storage bags on the chemical composition of brown and white rice grain.

MATERIALS AND METHODS

The present study was conducted jointly by the Rice Technology and Training Center, (RTTC) Alexandria, and the Food Technology Research Institute, (FTRI), Giza, Egypt, during 1999-2000 season. This study aimed to determine the effect of some storage conditions on the chemical composition of rice grain of different Egyptian rice varieties. These conditions were storage periods and storage bags. Five varieties namely; Giza 178, Sakha 101, Sakha 102, Giza 181 and Egyptian Yasmine were used. Two laboratory experiments were conducted under this study:

1- The effect of storage period on the chemical composition of rice grain.

Fresh harvested paddy samples of the aforementioned rice varieties were obtained from the harvested crop in 1999-2000 season. Three samples / period / variety

were randomly taken, cleaned and dried till 14% moisture content and then bagged in 50 kg capacity jute sacks. The 60 samples were stored in a well protected clean closed store for 3,6 and 9 months. At the end of each storage period three samples from each stored sample were dehulled and another three were milled and subjected to determine the chemical composition of the brown and milled rice respectively. In addition, samples of the fresh paddy (zero time) were chemically analyzed as a control.

2- The effect of storage bags on the chemical composition of rice grain.

A total of 45 paddy samples, (3 samples / variety / bag type) at 14 % moisture content harvested in 1999-2000 season from the five rice varieties were cleaned and stored for 12 months in three types of storage bags. These types were jute sacks, striped plastic bags and paper bags. The capacity of each of storage bags was 50 kgs. The samples were stored in a well airated closed warehouse and well protected from insects and rodent attack. After one year storage period, three random samples from each storage bag were dehulled and another three samples were milled and used to determine the chemical composition of both brown and milled rice.

Chemical analysis:

The following chemical consistitutents were studied in the tow experiments for both brown and milled rice grain. Moisture, protein (Nx 5.95), crude oil and ash were determined according to the methods of A.O.A.C. (1990). Amylose content was detected by the simplified assay method of Juliano (1971).

Statistical analysis:

Data of each experiment were statistically analyzed as completely randomized design in factorial arrangement according to Panse and Sukhatme (1985). The varieties were allocated as factor A, while the storage period or storage bags were allocated as factor b.

RESULTS AND DISCUSSION

1- The effect of storage periods on the chemical composition of rice grain:

As evident from Table 1, significant differences between varieties were not detected for grain moisture content for both brown and white rice. On the other hand, moisture content decreased significantly by increasing storage period, between 6 and 9 months storage period.

Furthermore, Table 1 indicates that varieties differed significantly in protein content. Moreover, protein content was decreased with milled rice, this is attributed to removal of the outer layers of the grain during milling that contain some of the total protein content.

Regarding to the effect of storage time on the chemical composition, protein content significantly decreased by increasing storage period. The highest decrease was obtained after 9 months for both brown and white rice. Dhaliwal *et al.* (1991) and Koo (1999) reported that during storage of paddy, water soluble protein were reduced. This reduction was regarded as the denaturation and insolubilization of protein at the end of storage period. It occurred more significantly in the conventional storage than in the air-tight storage. However, Song and Hong (1988) and Wang and Hsieh (1988) found that no change in the water and alkali soluble protein contents occur during the storage.

In addition, the tested varieties showed significant differences to crude oil in brown rice, however insignificant differences were calculated in milled rice. This proves that, the most of the crude oil is presented in the outer layers and the embryo of the rice grain (Table 1). On the other hand, results indicate that increasing storage time decreased significantly the crude oil content in both brown and milled rice. The highest decrease was recorded after 9 moths of storage. In contrast, Wang and Hsieh (1988), reported that free fatty acids are increased with the increase of pH value as the storage period is prolonged. However, Dhaliwal *et al.* (1991), reported that no significant effect on crude fat content was found by storage.

Highly significant differences between varieties in amylose content were observed. In general, it is worthy to note that milled rice contains higher amylose content than the brown rice for all varieties. This is because the amylose is presented mainly in the starchy endosperm and less are removed during milling, accordingly its percentage in the white grains will relatively increase after milling.

Regarding the effect of storage time on the amylose content, Table 1 further indicates that significant increase of amylose content was estimated by increasing storage time for both brown and milled rice. The highest increase was detected after 9 months storage period. This result might be due to the degradation of the glycoside bonds 1-6 in the branched portion of the starchy endosperm (amylopectin) due to increasing storage time and consecquantly transferred to amylose. This result is in agreement with El-Kady and El-Hissewy (1994). On the other hand, Yang *et al.* (1995) indicated that total and soluble amylose content of rice starch decreased with increasing storage period, whereas, Paul (1977) and Song and Hong (1988) reported that one year storage period did not affect amylose content.

Table 1: Analysis of variance of the effect of storage period on the chemical composition of rice grain during 1999 - 2000 season.

S.O.V.	d.f.	MS									
		Moisture %		Protein %		Oil %		Amylose %		Ash %	
		Brown	White	B	W	B	W	B	W	B	W
	.	(B)	(W)								
Varieties (V)	4	0.989*	0.438	1.039*	1.374*	1.812*	0.614	2.954**	3.672**	0.925*	0.677
Storage Period (P)	3	0.511	0.571	1.134*	3.529**	3.695**	3.079**	0.514	0.396	0.488	0.412
Interaction (VxP)	12	0.511	0.437	0.516	0.413	0.366	0.415	0.428	0.428	0.407	0.39
Error	40	11.251	12.679	13.782	14.664	12.746	14.256	12.152	11.187	10.678	11.829

* & ** Significant and higly significant at 0.05 and 0.01 levels, respectively.

Table 2: Analysis of variance of the effect of different types of storage bag on the chemical composition of rice grain during 1999 - 2000 season.

S.O.V.	d.f.	MS									
		Moisture %		Protein %		Oil %		Amylose %		Ash %	
		Brown	White	B	W	B	W	B	W	B	W
	.	(B)	(W)								
Varieties (V)	4	0.617	0. 589	0.839*	0.792*	1.085*	0.542	3.941**	4.022**	0.982*	0.563
Storage Bags (B)	2	0.538	0.543	4.092*	5.313**	3.772**	2.895**	4.785**	4.672**	0.432	0.447
Interaction (VxB)	8	0.552	0.927	0.369	0.406	0.411	0.319	0.516	0.516	0.315	0.494
Error	30	19.216	20.873	12.056	13.712	11.815	10.536	13.719	13.719	16.948	18.25

* & ** Significant and higly significant at 0.05 and 0.01 levels, respectively.

Ash content appeared to be differ significantly between varieties in case of brown rice only, however, insignificant differences were obtained between the white rice grains of the different varieties. On the other hand, no significant differences in ash content were obtained due to storage period for both brown and white rice.

2- The effect of different storage bags on the chemical composition of rice grain.

Table 2 indicates that after one year storage period moisture content differed significantly between varieties in case of brown grains only. Differences between storage bags were not significant indicating that moisture content was not affected by storage bags.

Protein content showed significant and highly significant differences due to storage bags for both brown and white grains, respectively, (Table 2). The higher protein content was detected for the paper bags, while the lowest content was found for the plastic bags. Same trend was recorded for oil content indicating that such content was significantly affected by different storage bags and was maximized when jute sacks were used, while it was minimized by using the plastic bags. In contrary, amylose content and ash (%) were not affected by different storage bags. Moreover, the interaction between varieties and storage bags was not significant for all studied components. These results are in agreement with those reported by Champagne *et al.* (1996) and El-Kady and El-Hissewy (1999). However, Pushapamma and Reddy (1979) found that sealed polyethylene bags provided the best shelf life for brown rice.

Finally it could be concluded that the chemical composition of the rice grain, except ash, were significantly affected by increasing storage period more than 6 moths. However, storage bags affected only protein content and oil content. Paper bags and / or jute sacks showed the lowest effect on such contents. Accordingly, six months storage period and paper bags or jute sacks proved to be the best storage types for rice to prevent the chemical composition deterioration in rice grain after harvest for the rice varieties under study.

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دراسة تاثير فترات وعبوات تخزين الأرز الشعير على التركيب الكيماوى لحبوب لبعض أصناف الأرز المصريه

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أجريت هذه الدراسة بمركز تدريب تكنولوجيا الأرز بالإسكندرية بالتعاون مع معهد بحوث تكنولوجيا الأغذية - مركز البحوث الزراعية خلال موسم عام ١٩٩٩ - ٢٠٠٠ لدراسة تأثير مدة التخزين وعبوات التخزين على التركيب الكيماوى لحبوب الأرز

إستخدمت فى التجربة الأولى ٦٠ عينة (٣ عينات / مدة التخزين / صنف) عينات من الأرز الشعير لخمس اصناف مصرية هى جيزة ١٨٧ ، سخا ١٠١ ، سخا ١٠٢ ، جيزة ١٨٢ ، ياسمين وقدرت المكونات الكيماوية للحبوب عند الحصاد مباشرة (بدون تخزين) وبعد ٣ -٦ - ٩ أشهر تخزين. وإستخدمت فى التجربة الثانية ٤٥ عينة (٣ عينات / صنف / نوع العبوة) وكانت أنواع العبوات المستخدمة فى التخزين خلال التجربة هى أجولة جوت (خيش) - بلاستيك مجدول واكياس ورقية سعة ٥٠ كم وتم تقدير تاثير نوع العبوات على المكونات الكيماوية بعد تخزينها امدة عام وذلك بعد عام من الحصاد.

أوضحت النتائج أن الأصناف إختلفت إختلافا معنويا فى المكونات الكيماوية وأن زيادة مدة التخزين عن ٦ أشهر أثرت معنويا على جميع المكونات الكياوية للحبوب عدا الرماد بينما إنخفضت نسبة الرطوبة والبروتين والدهون إنخفاضا معنويا بعد هذه الفترة ، من ناحية أخرى أدت زيادة فترة التخزين إلى زيادة نسبة الأميلوز زيادة معنوية

أما بالنسبة لتأثير عبوات التخزين فقد أظهرت النتائج أن المكونات الكيماوية للحبوب لم تتأثر معنويا بإختلاف العبوة فيما عدا نسبتى البروتين والزيت.

وبصفة عامة كان التفاعل بين الأصناف ومعاملات التخزين المختلفة غير معنويا بالنسبة لجميع المكونات الكيماوية تحت الدراسة.

وعلى ذلك يمكن إستنتاج أنه يمكن تخزين حبوب الأرز الشعير عند نسبة رطوبة ١٤٪ لمدة لاتزيد عن ٦ أشهر فى عبوات ورقية أو جوت دون اى تغيرات معنوية فى التركيب الكيماوى للحبوب.