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Effects of Redrying Methods on the Milling Potential, Crude Protein and Total Phenolic Content, and Antioxidant Activity of Stored Inorganic and Organically-Grown Paddy

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This study sought to determine the effects of redrying techniques (no redrying or Control, 2-h, 4-h, and 6-h redrying with stirring every 30 min, Farmer's Practice or 6-h redrying with one stirring) on grain quality of stored inorganic and organic paddy rice as well as the redrying method that gives the best quality rice. PSB Rc82 rice harvested in October 2016 was used in the experiment conducted in February 2017. Quality parameters evaluated were moisture content, brown rice, total milled rice, crude protein content in percent, total phenolic content, and 2-2 diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. PSB Rc82 paddy exposed to various redrying techniques had moisture contents ranging between 9.10% – 11.60% moisture content (wet basis) (MCw.b.). Brown rice (70.19% – 72.52%), total milled rice (66.37% – 69.12%), crude protein content (6.60% – 7.73%), total phenolic content (0.0783 – 0.0950 mg g^{-1} GAE), and % DPPH radical scavenging activity (19.53 – 26.87) of PSB Rc82 rice were all significantly influenced by redrying process and type of rice (*p* = 0.05). The 2-h redrying produced maximum brown and milled rice recoveries while removing the least amount of moisture from paddy samples. Control (no redrying) had the highest crude protein content. Inorganic rice had more crude protein and was more nutrient-dense than organic rice. Samples dried at 4-h redrying with 30-min stirring intervals produced the highest % DPPH radical scavenging activity. Moreover, DPPH radical scavenging activities were higher in inorganic rice than in organic rice. Variations between inorganically and organically-grown rice in terms of crude protein content and antioxidant activity with different redrying methods may be attributed to crop management. Findings from this study can help other researchers in determining the best redrying method to attain maximum grain quality and health benefits important to consumers.

Keywords: antioxidant activity, crude protein content, inorganic rice, milling potential, organic rice, redrying, total phenolic content

INTRODUCTION

The quality of rice, which encompasses good nutritional quality, taste, good eating quality appearance, and aroma, is a key determinant of its marketability and economic value. For instance, the head rice or milled rice whole kernel with more than 75% length (Xangsayasane et al. 2018) sells at a much higher price, about double that of broken rice (Philippine Rice Postproduction Consortium 2002). The demand for organic or organically-grown rice has been steadily rising year after year because of the health advantages it provides. These types of rice have gained popularity and are selling for more money. Due to concerns over food safety and the environment, customers are favoring rice that is farmed organically (Kifayatullah et al. 2006). According to Tafere et al. (2011), organically cultivated rice offers higher nutritional advantages because it is only grown with organic additives, materials, fertilizers, and pesticides, while inorganic rice uses large amounts of inorganic fertilizers and pesticides. Aside from the inherent characteristics of the variety, environment, crop management practices, and nutrient management of the rice crop (i.e., inorganic or organically-grown), the grain quality is also influenced by postharvest operations which include harvesting, drying, storage, and milling.

In the Philippines, many farmers store paddy after it is harvested, cleaned, and dried to a moisture content of around 12% – 14% for safe storage. Drying is being done to preserve the grains, making them available for several months until the next harvesting season. Farmers usually set aside portions of their rice harvest for rice consumption. On the other hand, paddy traders and millers maintain some stocks in their warehouses and mill the grains to sell them as milled rice. It has been a practice of many farmers and rice processors to dry the stored grains just before milling to attain higher milled rice output and, consequently, higher income. Redrying of stored paddy is usually done for half a day, stirring the grains once, regardless of the moisture content. Rice milling is a process where paddy is transformed into milled rice that is suitable for human consumption (Philippine Rice Postproduction Consortium 2002). The husk or hull (outer covering of the rice grain) is removed followed by polishing or bran removal. The quality of milled rice is affected by the quality of paddy, milling equipment, and varieties used, among others (Kumoro et al. 2019). The moisture content of the grains during harvesting, drying, milling, and storage affects milled rice quality (Firouzi and Alizadeh 2013). The recommended moisture content of paddy for long-term storage should not be higher than 14% moisture content (wet basis) (MCw.b.), while for milling purposes, 14% MCw.b. is recommended to attain maximum milling yield and head rice (Philippine Rice Postproduction Consortium 2002). At 13% − 14% MCw.b., the paddy can resist compressive strength (IRRI 2013). Proper drying techniques are essential to reduce the moisture content of rice since they have an impact on milled rice and head rice recovery (Poomsa-ad et al. 2005).

There have been several studies conducted on the effects of drying on the quality of rice, i.e., sundrying on milling yield and rice quality (Imoudu and Olufayo 2000); drying temperature and moisture content on rice taste quality (Zheng and Lan 2007); drying and milling modes on white rice quality (Kumuro et al. 2019); and high-temperature drying on rice quality (Wiset et al. 2001). However, most, if not all of these works mainly involved newly harvested paddy—there are no studies yet involving the short redrying of stored paddy just before the milling operation, which is a practice of many farmers and processors to achieve better milling quality output.

It is hypothesized that a redrying of stored paddy just before milling results in higher milling recovery and may affect other equally important parameters which include crude protein, phytochemical content, and % DPPH radical scavenging activity of rice. Results from previous literature support this claim—Imoudu and Olufayo (2000) reported that the method of sundrying and moisture content of the dried grains before milling significantly affected the milling yield and the percentage of broken grains. Moreover, the critical drying temperature of 45°C for paddy with an initial MCw.b. of 21.36% induced the rice taste value to decline significantly (Zheng and Lan 2007). Findings reported by Kumoro et al. (2019) stated that shallow-bed or sundrying on a concrete floor followed by milling with dehusking, separation, and polishing done only once produced the highest head rice yield with acceptable whiteness and nutritional composition.

The study's objectives were to determine the impact of various redrying techniques/strategies on grain quality (milling potentials, crude protein and total phenolic content and antioxidant activity of stored inorganic and organic paddy) and to identify the redrying technique that results in the best quality of inorganic and organically grown rice.

MATERIALS AND METHODS

Samples Used

The experiment was carried out in February 2017 at PhilRice Batac, City of Batac, Ilocos Norte, Philippines. The PSB Rc 82 paddy samples (inorganic and organically-grown) harvested 30 d after flowering (DAF) during the 2016 wet season were used. These were sundried following the *Palay*check recommendation where the grains were spread on plastic nets that were 2 − 4 cm thick and were stirred every 30 min to achieve uniform drying. The dried paddy samples were then stored in sacks at

Table 1. The types of rice and redrying methods used in the experiment.

Type of PSB Rc 82 Rice	Redrying Method
Inorganic, harvested 30 d after flowering (DAF)	Control (no redrying)
	2-h redrying, every-30-min stirring
	4-h redrying, every-30-min stirring
	6-h redrying, every-30-min stirring
	Farmer's Practice, 6-hr redrying, 1 stirring
Organically-grown, harvested 30 DAF	Control (no redrying)
	2-h redrying, every-30-min stirring
	4-h redrying, every-30-min stirring
	6-h redrying, every-30-min stirring
	Farmer's Practice, 6-h redrying, 1 stirring

ambient temperature for 3 mo before they were redried through different sundrying methods before milling.

Redrying

Table 1 shows the factors employed in the redrying experiment. The stored paddy samples were spread on plastic nets that were 2 − 4 cm thick. As per *Palay*check's recommendation, the grains were stirred every 30 min to achieve uniform drying. A destructive moisture meter was used to determine the initial MCw.b. of the inorganic and organically-grown paddy samples (grain moisture meter, G-Won, Model GMK-303, Korea). Temperature, relative humidity, and grain moisture contents of the samples subjected to the different redrying methods were all periodically monitored. Following redrying, the samples were allowed to cool before being dehulled using the SATAKE testing husker (Model 35A, Satake, Co., Hiroshima, Japan) and polished using the McGill No. 2 Mill (Seedburo Equipment Co., USA) to determine the recoveries of brown rice and milled rice. The grain quality of the milled rice samples was assessed by the Rice Chemistry and Food Science Division at the PhilRice Central Experiment Station in Maligaya, Muñoz, Nueva Ecija, Philippines.

Grain Quality, Antioxidant Activity, and Total Phenolic Content Evaluation

The paddy moisture contents were determined from the beginning until the end of the redrying methods using an electronic instrument that uses electrical characteristics of the grains (http://www.knowledgebank.irri.org). The digital moisture meter was used where the average of five readings was taken per experimental unit, before and after redrying. Brown rice and milled rice yields of the redried PSB Rc 82 paddy and protein content of the milled rice were evaluated as described in the National Cooperative Testing (NCT) manual (PhilRice 1999). The method of Singleton et al. (1999) was modified to determine the milled rice total phenolic content of the methanolic extracts. The antioxidant activity of the milled rice of PSB Rc 82 paddy was evaluated using the DPPH radical-scavenging assay developed by Brand-Williams et al. (1995), also with slight modifications. Sample extract and Trolox standard solutions were mixed with 5 mL 0.1 mM DPPH working reagent and allowed to stand at room temperature for 1 h. The resulting absorbance was measured at 517 nm against a blank and the antioxidant activity was expressed as Trolox equivalents in μg Trolox per g sample. Antioxidant activity was then calculated using the following formula:

$$\text{Antioxidant Activity (\%)} = \text{Abs (blank)} - \text{Abs (extract)} / \text{Abs (blank)} \times 100$$

Statistical Analysis

The effects of redrying techniques on the quality of rice cultivated inorganically and organically were examined using ANOVA through the Rcropstat software for two-way factorial in a completely randomized design (CRD). The variations in the two components' levels during redrying operation were ascertained using the LSD test. The best redrying technique was also identified, i.e., the treatment(s) that produced the highest-quality rice, both from inorganic and organic farming. The effects of redrying methods and type of rice as well as their interactions on the different grain quality parameters of milled PSB Rc 82 were also determined.

RESULTS AND DISCUSSION

Effects of Redrying Methods and Type of Rice on the Moisture Content of PSB Rc 82 Paddy

The final moisture content of the redried PSB Rc 82 paddy was affected by the redrying method (Table 2). The 2-h redrying removed the least amount of moisture from the grain samples followed by Farmer's Practice which entailed a 6-h redrying with one stirring. The 4-h and 6-h redrying with stirring every 30 min had comparable, if not lower, moisture contents. This is due to the fact that the frequent stirring facilitated the faster drying of the paddy samples, as the grains in the bottom layer and with higher moisture content can be moved to the top layer and be the next to be directly exposed under the heat of the sun. In using Farmer's Practice, the grains at the

Table 2. Moisture content of PSB Rc 82 as affected by redrying methods. PhilRice Batac. (Mean ambient temperature: 33.5°C; Mean RH:55%).

Redrying Method	Final Moisture Content (%)		Mean
	Organically-Grown	Inorganic	
Control (No redrying)	11.60	11.50	11.55[a]
2-h redrying (every 30 min stirring)	10.70	10.20	10.45[b]
4-h redrying (every 30 min stirring)	9.70	9.40	9.55[d]
6-h redrying (every 30 min stirring)	9.40	9.10	9.25[e]
Farmer's Practice (6 h, 1 stirring)	9.70	9.90	9.80[c]
Significance			
Redrying Method (D)	***		
Rice Type (T)	ns		
D x T	ns		

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; ***highly significant at 0.1% level; ns-not significant.

Table 3. Results of analyses of variances of various quality parameters.

Source of Variation	BR	MR	CPC	DPPH	TPC
Redrying Method (D)	*	**	***	***	***
Rice Type (T)	ns	ns	***	**	ns
D x T	ns	ns	***	***	ns

***highly significant at 0.1% level; **significant at 1% level; *significant at 5% level; ns-not significant.

bottom layer will just wait for the time that the drying front reaches the bottom, causing the grains at the top to be overdried and those at the bottom to be underdried. Stirring the grains every 30 min during redrying facilitates faster and more even drying, resulting in the higher moisture content in the Farmer's Practice than in the 4-h and 6-h redrying. This also explains why the 6-h redrying gave the lowest moisture content. As the redrying continued, there was also continuous removal of moisture from the grains.

Effects of Redrying Methods and Type of Rice on Milled Rice Quality of Stored PSB Rc 82 Paddy

Table 3 shows the effects of redrying method and type of rice as well as their interactions on the different grain quality parameters of milled PSB Rc 82. The milled rice and brown rice recoveries and total phenolic content of PSB Rc 82 were significantly affected by the redrying method. Crude protein content and DPPH radical scavenging activity were strongly impacted by the redrying method, type of rice, and interactions between these factors.

Milling Potentials

% Brown Rice and % Milled Rice

Regardless of the moisture content of the stored paddy, majority of farmers and rice processors redry the paddy with the belief that short redrying before milling gives better milling output. The recommended moisture content of paddy for milling is 14% MCw.b.

Table 4. Brown rice recovery of PSB Rc 82 (organically-grown and inorganic) as affected by redrying methods. PhilRice Batac. 2017 DS.

Redrying Method	Brown Rice Recovery (%)		Mean
	Organically-Grown	Inorganic	
Control (No redrying)	69.87	70.51	70.19[c]
2-h redrying (every-30-min stirring)	72.41	72.64	72.52[a]
4-h redrying (every-30-min stirring)	72.14	71.76	71.95[ab]
6-h redrying (every-30-min stirring)	70.38	71.77	71.08[bc]
Farmer's Practice (6 h, 1 stirring)	70.22	70.50	70.36[c]
Significance			
Redrying Method (D)	*		
Rice Type (T)	ns		
D x T	ns		

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; *significant at 5% level; ns-not significant.

The highest brown rice and milled rice recoveries were from the 2-h redying with 30-min stirring, followed by the 4-h and 6-h redrying (Tables 4 and 5). The lowest brown rice recoveries were obtained from using the Farmer's Practice and the control. The shorter exposure to high temperatures may have had an impact on the milling quality of the grain. The lowest brown rice recoveries were also obtained from using the Farmer's Practice and the control, which means that over redrying or no redrying of the stored paddy also resulted in low % brown rice and % total milled rice. The undried paddy may have been less elastic and rubbery using the control, which led to more breakage and worse recoveries of brown and milled rice. Lower brown rice and milled rice recoveries for the Farmer's Practice may be related to a longer exposure to high temperatures and uneven drying. There may have been changes in the states of the starch in rice (a biopolymer) that occurred at the glass transition temperature or Tg (temperature at which an amorphous solid such as a polymer transitions from a rubbery to a glassy state, or vice versa—when it becomes brittle on cooling, or soft on heating) (Cnossen and Siebenmorgen 2000). This transition plays an important role in rice fissuring and breakage as a result of drying (Cnossen and Siebenmorgen 2000). Drying parameters, such as drying rate and fissure initiation in the rice kernel, are significantly influenced by whether a rice kernel is above or below the Tg (Siebenmorgen et al. 2004). According to Cnossen et al. (2002), rice is in a glassy state when rice kernel temperature is below Tg, starch granules are compact, and water associated with the starch is relatively immobile. In this study, the kernel temperature of the control may have been below the Tg and still at a glassy state, and there was no transition from the glassy to the rubbery state since there was no redrying conducted before milling. The 2-h redrying at ambient

Table 5. Milled rice recovery of PSB Rc 82 (organically-grown and inorganic) as affected by redrying methods. PhilRice Batac. 2017 DS.

Redrying Method	Milled Rice Recovery (%)		Mean
	Organically-Grown	Inorganic	
Control (No redrying)	66.45	67.95	67.20[bc]
2-h redrying (every-30-min stirring)	68.54	69.71	69.12[a]
4-h redrying (every-30-min stirring)	68.90	68.05	68.47[ab]
6-h redrying (every-30-min stirring)	67.14	68.43	67.79[ab]
Farmer's Practice (6 h, 1 stirring)	66.19	66.55	66.37[c]
Significance			
Redrying Method (D)	**		
Rice Type (T)	ns		
D x T	ns		

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; **significant at 1% level; ns-not significant.

temperature (26°C – 30.2°C) before milling may have been the optimum condition when the rice kernels (10.45% MCw.b.) reached the Tg, when they changed from the glassy to the rubbery state and became soft and elastic, thus resulting in less breakage and higher brown rice and milled rice recoveries. Glass transition temperatures were found by Tajaddodi Talab et al. (2012) to range from 9.65°C to 61.79°C for grains with moisture contents of 26.8 – 7.4 %MCw.b. Tg values of rice kernels are inversely dependent on moisture content (Siebenmorgen et al. 2004). On the other hand, if the drying temperature is higher than Tg, rice starch is in a rubbery condition, starch macromolecules have more free volume, and water in the starch is more mobile (Slade and Levine 1991). As a result, moisture can diffuse out of kernels more quickly. However, because surface moisture is removed more quickly than moisture in the interior of the kernel, the moisture content gradient increases as moisture removal speed increases. The gradients in the kernel's moisture content create stress that might lead to cracks. The 4- and 6-h redrying and Farmer's Practice had lower brown rice and milled rice recoveries, perhaps due to the fact that drying air temperature (30.2°C – 40.6°C for the 4-h redrying) would be higher than the Tg. This caused faster and greater moisture removal than the 2-h redrying, resulting in greater moisture content gradients in the kernels that created fissures and breakage.

Physicochemical Properties

Crude Protein Content

The crude protein content indicates the nutritional value of rice (Juliano 2010). The highest crude protein contents of PSB Rc 82 were obtained when the samples were not redried (control) before milling, both for inorganic and organically-grown rice (Table 6). This is because the drying process or removal of water from the rice, which is directly affected by temperature, may have caused nutritional losses (Agoreyo et al. 2011) including crude protein content and total phenolic content that subsequently affect antioxidant activity.

However, for the inorganic rice, the control was not significantly different from the 2- and 4-h redrying and Farmer's Practice; the lowest was obtained from the 6-h redrying.

For the organically grown rice, the lowest crude protein contents were obtained from the 6-h drying and Farmer's Practice. The 2-h and 4-h redrying were not significantly different from each other, as well sa with the 6-h redrying and Farmer's Practice. As the redrying duration was prolonged from no redrying, 2-h to 4-h, and 6-h redrying and Farmer's Practice, the crude protein contents decreased significantly. These findings confirm the report of Agoreyo et al. (2011)—due to biochemical and nutritional variations in the food composition, the drying process or removal of water from the food caused nutritional losses.

The unredried inorganic and organically-grown PSB Rc 82 rice had comparable crude protein contents (Fig. 1). Organically produced rice had considerably lower crude protein levels than inorganically cultivated rice for all redried samples. Previous studies reported that inorganic rice showed significantly higher protein (7.25%) as compared to organic rice (5.57%) (Joshi et al. 2019).

Table 6. Comparison of the crude protein contents of PSB Rc 82 rice redried by different methods at each level of type.

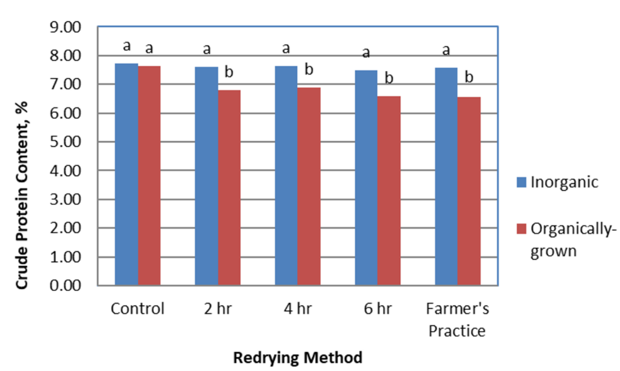
Redrying Method	Crude Protein Content (%)	
	Inorganic	Organically-grown
Control (No redrying)	7.73[a]	7.63[a]
2-h redrying (every-30-min stirring)	7.60[ab]	6.80[b]
4-h redrying (every-30-min stirring)	7.63[ab]	6.90[b]
6-h redrying (every-30-min stirring)	7.50[b]	6.60[c]
Farmer's Practice (6 h, 1 stirring)	7.57[ab]	6.57[c]
Significance		
Redrying Method (D)	***	
Rice Type (T)	***	
D x T	***	

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; ***highly significant at 0.1% level.

Antioxidant Activity

2,2′-diphenyl-1-picrylhydrazyl (DPPH) Radical Scavenging Activity

The % DPPH radical scavenging activity is a measure of the antioxidant activity. It is the ability to scavenge free radicals in the human body, thereby reducing the amount of free radicals and damage to biological molecules like



Means/bars with the same letters are not significantly different from each other at 5% level using LSD.

Fig. 1. Comparison of the crude protein contents of the two types of PSB Rc 82 Rice at each level of redrying method.

Table 7. Comparison of the % DPPH radical scavenging activities of PSB Rc 82 rice redried by methods at each level of type.

Redrying Method	% DPPH Radical Scavenging Activity	
	Inorganic	Organically-grown
Control (No redrying)	26.37[ab]	22.70[c]
2-h redrying (every-30-min stirring)	25.23[c]	19.53[e]
4-h redrying (every-30-min stirring)	26.87[a]	26.83[a]
6-h redrying (every-30-min stirring)	26.17[b]	25.27[b]
Farmer's Practice (6 h, 1 stirring)	24.57[d]	21.03[d]
Significance		
Redrying Method (D)	***	
Rice Type (T)	**	
D x T	***	

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; ***highly significant at 0.1% level; **significant at 1% level.

Table 8. Total phenolic content of milled PSB Rc82 rice (organically-grown and inorganic) harvested at 30 DAF as affected by redrying methods. PhilRice Batac, 2017 DS

Redrying Method	Mean
Control (No redrying)	0.0950[a]
2-h redrying (every-30-min stirring)	0.0867[b]
4-h redrying (every-30-min stirring)	0.0917[a]
6-h redrying (every-30-min stirring)	0.0933[a]
Farmer's Practice (6 h, 1 stirring)	0.0783[c]
Significance	
Redrying Method (D)	***
Rice Type (T)	ns
D x T	ns

Means in a column with the same letter are not significantly different from each other at 5% level using LSD; ***highly significant at 0.1% level; ns-not significant.

lipids and DNA (Wu et al. 2004). Radical scavenging activities are crucial in limiting their harmful effects in a variety of disorders, including cancer (Rahman et al. 2015).

When redried for 4 h with 30-min stirring intervals, the samples of PSB Rc 82 rice cultivated inorganically and organically were comparable in terms of their % DPPH radical scavenging capabilities (Table 7). At no redrying (control), 2-h and 6-h with every-30-min stirring, and Farmer's Practice, the inorganic rice had higher % DPPH radical scavenging activities than the organic rice.

The highest % DPPH radical scavenging activities were obtained with 4-h redrying with every-30-min stirring, regardless of whether it was inorganic or organically grown (Table 7). This may have been caused by longer exposure to heating which may have released the bound phytochemicals such as phenolic compounds and, subsequently, the antioxidant activity as measured by the % DPPH radical scavenging activities. The 2-h redrying was the lowest compared with the 4-h and 6-h redrying with every-30-min stirring. Hence, the 4-h redrying with every-30-min stirring may be the optimum duration when the % DPPH radical scavenging activities would be highest. The milled rice from the redried PSB Rc 82 paddy had the highest % DPPH radical scavenging activity or the best ability to prevent oxidation of other molecules when it was in this optimal condition, which may have health-promoting effects in the prevention of disorders (Rahman et al. 2015). However, for the inorganic rice, the control (no redrying) was comparable to the 4-h redrying with every-30-min stirring. The lowest % DPPH radical scavenging activities were observed when the samples were redried following Farmer's Practice.

Phytochemical Content

Total Phenolic Content

The function of the antioxidant- and radical-scavenging properties of phenolic substances is to protect cell constituents against oxidative damage since they are able to donate hydrogen and form relatively stable resonance hybrids of delocalized unpaired electrons, allowing the molecule to act as reducing agents, single oxygen quenchers, and free radical hydrogen donors (Thanajiruschaya et al. 2010). The PSB Rc 82 rice's total phenolic content was the highest when the samples were left undried (control) and exposed to 4-h and 6-h redrying with 30-min intervals of stirring, while it was the lowest when samples were dried according to Farmer's Practice, whether the rice was farmed inorganically or organically (Table 8). The total phenolic content dropped as the samples underwent 2-h redrying with 30-min intervals of stirring; this may be because of the free phenolic compounds evaporating throughout the redrying process. The lowest phenolic content was observed from the 2-h redrying compared with 4-h and 6-h redrying with every-30-min stirring, similar to the antioxidant activity (% DPPH radical scavenging activities). This finding may be a result of the shortest drying time where it had not caused the release of bound phenolics that would subsequently increase the antioxidant activity. The concentration of the total phenolic content increased as the redrying time increased (4-h and 6-h redrying with every-30-min stirring), which may have been caused by the enzymatic or non-enzymatic release of the bound phenolic compounds and resulted in a higher total phenolic content than when the samples were redried for 2 h. The samples that were redried after the 2-h, 4-h, and 6-h drying times with 30-min intervals of stirring had higher total phenolic contents than the Farmer's Practice samples. This may be because the stirring, which facilitated the drying process, also caused the release of bound phenolics. The length of redrying and the stirring of the grains may be responsible for variations in the concentration of total phenolic content in the redried samples. According to Tyagi et al. 2022, phenolic compounds can be found in the endosperm and bran/embryo fractions of rice grains in three different states—free, soluble-conjugated, and bound—which define the stability of the compound when exposed to various conditions such as redrying methods conditions; hence, the changes and variations in the total phenolic compounds of the grains. The longer the redrying period and more frequent stirring (6-h drying with 30-min intervals of stirring) had higher total phenolic content than the 2-h and 4-h redrying and Farmer's Practice because of the release of the bound phenolics which can be found in the endosperm.

CONCLUSION

The redrying method and type of rice significantly impacted (p = 0.05) the moisture content, brown rice recovery, milled rice recovery, crude protein content, % DPPH radical scavenging activity, and total phenolic content of stored PSB Rc 82 paddy. The 2-h redrying (with stirring every 30 min) removed the least amount of moisture from the grain samples and provided the best brown rice and milled rice recoveries while the Control or no redrying produced the highest crude protein contents of PSB Rc 82. As the redrying duration was prolonged, the crude protein contents decreased regardless whether inorganic or organically-grown rice. The crude protein content and % DPPH radical scavenging activity were higher in inorganic rice than in organic rice, indicating that inorganic rice is more nutrient-dense and has a greater ability to prevent oxidation of other molecules, which in turn may have greater health-promoting benefits that aid in the prevention of degenerative illnesses. These variations in the responses of inorganic and organic rice may be due to their crop management, particularly on nutrient management. On the other hand, the highest % DPPH radical scavenging activities were obtained when redried at 4-h redrying with every-30-min stirring while the highest total phenolic content was obtained when samples were not redried (control) and subjected to 4-h and 6-h drying times with 30-min intervals of stirring. To obtain the highest antioxidant activity as measured by the % DPPH radical scavenging activity and the total phenolic content which may provide antioxidants and may have health-promoting effects, the paddy should be dried for 4 h with every-30-min stirring. The larger the percentage of DPPH radical scavenging activity and total phenolic content, the better and more advantageous rice is to human health. The 2-h redrying could help in attaining highest brown rice and milled rice recoveries; the 4-h redrying for highest % DPPH radical scavenging activity and total phenolic content; the Control or not redried samples for highest crude protein content; and the inorganic rice for higher crude protein content and % DPPH radical scavenging activity. Understanding the effects of redrying techniques on the quality of rice will help farmers and processors produce more and better quality rice.

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