SEED QUALITY, PHYSICAL PROPERTIES AND PROXIMATE COMPOSITIONS OF ADAN RICE.

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ABSTRACT

In the presence study, Adan rice was evaluated for seed quality, some physical and proximate compositions. The seed purity and moisture content and germination was 99.76±0.07%, 10.53 ±0.50% and 91.33±1.29% respectively. Adan rice seed took minimum 4 days to fully germinate. The physical properties of Adan Rice were evaluated at 12.03 ±0.14% moisture content. The length, width, thickness, 1000 grain weight, geometric mean dimension, surface area aspect ratio, and bulk density were 8.60mm, 2.13 mm, 1.67 mm, 15.28 g, 10.22mm, 27.04 24.83%, 0.50±0.01 g/ml respectively. Proximate composition analysis assessment was done using Association of Official Analytical Chemists (AOAC) method. The moisture content, ash, protein, fat, carbohydrate and fibre were 10.43%, 0.50%, 6.30%, 0.22%, 81.49% and 5.61%. Gelatinization temperature was determined by using alkali-digestion test. Adan rice has an intermediate gelatinization temperature.

Key words: Adan Rice, seed quality, physical properties, proximate composition

Introduction

Rice is one of the staple food of the world. It is a main caloric supply for most of the country in Asia and become a traditional crop for several regions in the countries. Adan Rice is a primary crop cultivated by the local people in the highland area of Borneo as their main daily caloric supply and main economic source because the rice can be sold at a high price due to the variety's traditional status and good taste. This rice variety is grown by the Lun Bawang in Ba'kelalan and Long Semadoh, Sarawak Malaysia, Lun Bawang in Krayan Indonesia as well as Kelabit farmers located in Bario, Sarawak. In Ba'kelalan and Long Semadoh and Krayan this traditional rice is called as Adan Rice but the local farmers in Bario call the same variety as Bario Rice. According to Kevin *et al.* (2007) the Bario rice or known as Adan Rice is well known for its soft texture, fine and elongated grains, mild aromas and splendid taste. This variety is currently planted and harvested traditionally in Krayan Indonesia, Ba'kelalan and Long Semadoh and some parts of Bario area. The variety is planted once in a year in July and harvested in January. The maturation period of this variety is 170 to175 days after sowing with 130cm to 135 cm height. Current potential production is 1.5-3.5 ton/ha (MARDI, 2014). There is no mechanization adopted in growing and harvesting process. There is minimum fertilizer usage where the soil is assumed to be fertile by the farmer. Usually the paddy straw will be left in the field after harvesting as a natural source of nutrient for the next planting. There is a shortage in the supply of Adan rice in the last quarter annually because of a high demand on the rice. The main constraint in the supply shortage is lack of knowledge in applying new technology among the farmer. Information on the variety is necessary to help in advancement and adopting of new technology in maximizing the rice production. Physical properties are useful for harvesting process, transportation, designation of storage system, manufacturing and post harvest mechanization (Ghadge and Prasad, 2012). Physiochemical and cooking quality are useful for the marketing purposes in giving information for the health conscious consumer. The seed quality study is important to give some information on the seed performance for cultivation. Therefore, this study was done to investigate some physical and physiochemical properties as well as seed quality of Adan rice. Seed quality test were done for high seed quality assurance followed by physical properties, physiochemical properties and gelatinization temperature of the rice respectively.

Material and Methods

Experiment was carried out in the Agronomic Laboratory and Tissue Culture and Cryopreservation Laboratory in Universiti Putra Malaysia Bintulu Campus, Sarawak, Malaysia.

Sample Preparation

Newly harvested Adan rice seeds were used as experimental material. Adan rice seed harvested in January 2015 was collected from three different places in Ba'kelalan Long Semadoh, Sarawak Malaysia, and Krayan Indonesia then form into a composite sample of one. . Only whole paddies without any physical damage or insect infestation were selected for further analysis. Moisture content of paddy and rice were measured using Grain Moisture Meter. The seeds collected were aerodynamically cleaned and placed in sealed (HDPE) plastic bag. A composite sample was made prior to use for each of the experiments such as purity, moisture and germination tests.

Purity test

Adan rice with 9 replications of 100 g seeds per replicate were prepared for seed purity test. The seeds were observed carefully and the existing of pure seeds, other seeds, weed seeds and inert matter were weighed and each seed components were then expressed in percentage.

Moisture content test

25 seeds per replicate were placed on crucible made from aluminum in 9 replications. The weight of empty crucible and crucible with 25 seeds per replicate were recorded before oven-dried in the oven at 60°C for 48 hours. The crucibles were reweighted after oven-dried and the moisture content was calculated as appended below:

Moisture content: $\frac{b-c}{b-a} \times 100$

a= weight of empty

b= a + seed weight before oven-dried

c= a +seed weight after oven-dried

Germination test

100 seeds per replicate of 4 replications were placed to germinate on 3 layers Whatman filter paper no.2 in 90 mm diameter petri dish. Filter papers within the petri dish were moistened daily to ensure sufficient water and expose to adequate sunlight for proper seed germination. Observations were made daily up to 7 days of germination.

Physical Properties

10 seeds per replication were randomly selected and the length, width and thickness were measured separately using digital vernier caliper. Similarly a 1000 seed weight was measured using electronic beam balanced. According to Jouki and Khazaei (2012), geometric mean dimension was calculated as:

$$D_e = (LWT)^{1/3}$$

Surface area (S_a) was calculated according to Ghadge and Prasad (2012) as:

$$S_a = \pi D_e^2$$

Aspect ratio was calculated according to Ghadge and Prasad (2012) as:

$$R_a = \frac{W}{L} \times 100$$

5 g of seeds was weighted and placed into a graduated glass measuring cylinder. The volume occupied by the seeds was recorded. Bulk density was calculated as g/ml (Thomas *et al.* 2012).

Proximate Composition Analysis

The physiochemical determination for moisture, ash, protein, fat, carbohydrate and fiber were done according to Association of Official Analytical Chemist (AOAC, 2000) standard. Standard method for carbohydrate content was determined by difference as equation below:

Carbohydrate (%) = 100% − (100% moisture + fat + protein + ash)

Rice gelatinization

Gelatinization temperature was analyzed by alkali spreading value (Little et al., 1958). Six grain of rice without cracks were selected and placed in petri dish and mixed with 10 ml of 1.7% (0.3035 N) potassium hydroxide (KOH). Samples were arranged to provide enough space between rice to allow for alkali spreading. Petri dishes were covered and incubated for 23 hours at 30°C in oven. Starchy endosperm was rated visually based on a 7 point numerical spreading scale.

Results and Discussions

Adan rice seeds obtained was 99.77 ±0.07% of purity after aerodynamic cleaning where as other components such as other seed and weed seeds were absent in the samples and a small portion of inert matter. The moisture content was 10.54±0.48% and germination percentage was 91.33±1.29% as observed after 7 days of sowing (Table 1). The high value of purity was because seeds undergone few stages of cleaning after harvesting, handling, drying and storage. Manual and traditional postharvest procedures were adopted by the farmers. High seed germination was probably due to minimum deterioration. The seeds were collected immediately following harvesting, drying and processing. According to Nicholas *et al.* (2013) seed aging decreased the seed quality in Bario rice. The quality of Adan rice seeds used in the research was high. This is because the initial purity, moisture content and germination of the seed were 99.77%, 10.54% and 91.33% respectively. According to seed Act (AOSA, 1985), seed lot for commercial trading must not less than 98.00% purity, 8-14% moisture content and 80% germination for orthodox seed such as rice. A superior quality seed not only increases productivity per unit area, but it also helps produce uniform crops without any admixtures, important for obtaining high prices on the market. Nguyen (2001) reported that high quality paddy results in high milling recovery and better quality rice in the market, which translates into increased profits.

Table 1: Seed quality of Adan rice

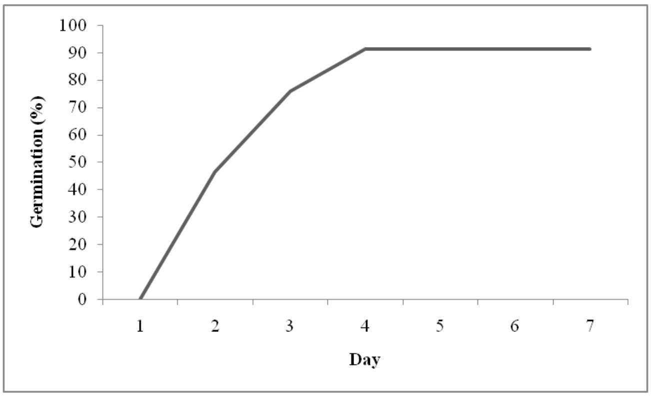
Purity (%)	Moisture Content (%)	Germination (%)
99.77±0.07	10.54±0.48	91.33±1.29

Purity analysis alsoincluded 0.00% other seed, 0.00% weed seed 0.23% inert matter, indicating that the Adan rice seed lot was of high quality as there is no other seed and weed seed (Table 2). Only zero percentage of weed seed is acceptable in international market.

Table 2: Purity of Adan Rice

Components	Percentage (%)
Pure seed	99.77±0.07
Other seed	0.00
Weed seed	0.00
Inert matter	0. 0.24±0.07
Total	100.00

Figure 1: The Germination Percentage of Adan rice from day 1 to day 7



The germination of Adan rice was started 2 days after sowing and the maximum number of germination percentage was on the fourth day and no more increment after the fourth day up to 7 days. The maximum germination percentage was 91.33±1.29%. ISTA (2007) considered germination test as the only test farmers can conduct on seeds to determine if it is suitable for planting. By knowing the germination rate, farmers can adjust their planting rates to attain the desired plant population in the field (ISTA, 2007). Ocran *et al.* (1998) reported that the minimum acceptable standard for germination percentage of certified seed rice in Ghana as 80% and above.

Table 3: Physical properties of Adan rice

Physical Properties	Unit of Measurement	Mean value	Min Value	Max Value	Standard Deviation	Standard Error
Length	mm	8.61	8.05	9.38	0.40	0.13
Width	mm	2.13	1.98	2.27	0.11	0.04
Thickness	mm	1.66	1.42	1.82	0.12	0.04
Weight 1000 grain	g	15.28	13.89	16.473	0.90	0.30
GMD*	mm	10.22	8.35	11.52	1.09	0.36
Surface Area	mm^2	27.04	21.39	31.05	3.29	1.10
Aspect Ratio	%	24.83	22.35	26.90	1.66	0.55
Bulk Density	g/ml	0.50	0.46	0.5320	0.02	0.01

* Geometric Mean Dimension

The physical properties of Adan rice are shown in Table 3. Grading the rice seed through sieves needed to know the length, width and thickness information. The Adan rice was classified as long grains with > 6.2 mm. According to Slaton *et al.* (2000) rice is marketed under three market types designated as long-grain, medium-grain, and short-grain. Weight of 1000 grains was 15.28±0.30g where this variety was classified as a moderately heavy since the weighed samples were below 20.0 g. This information is necessary for the design of machines for cleaning grains using aerodynamic forces. The low value of aspect ratio can explain that the paddy is difficult to roll in the milling machine however can slide on a flat surface. This is important as paddy grains are chaffy and useful in the design of hoppers in the milling of rice. The surface area was 27.04±1.10mm^2 where this value can determine the shape of the seeds and indicate the way the kernel behaves on oscillating surface during processing (Ghadge and Prasad, 2012).The efficiency of milling machine for rice depends on information derived from the physical properties of rice. The machine has to be designed properly in order to produce the desired quality of rice.

Table 4: Nutrient Composition of Adan rice

Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Fibre (%)
10.43 ±0.04	0.50 ±0.09	6.30 ±0.38	0.22 ±0.01	81.49 ±1.42	5.61 ±0.41

The moisture content of Adan rice was 10.43±0.04%. According to Webb (1985), moisture content plays a significant role in determining the shelf life. The shelf life is the storability of rice. If the moisture content is high and above 14%, it is prone to fungus infestation. A high percentage of broken kernels occurred in the milling process at low moisture content below 8%. Standard moisture content for brown rice (13-14%), white rice (13-14%) and bran (13-14%). The desired qualities include rice free from impurities, minimum broken kernels and improved storability. Ash content was 0.50±0.09% where this value can determine the level of essential minerals in rice (Bhat and Sridhar, 2008). The crude protein was 6.30±0.38%. Several factors can influence the protein content in rice including environmental stress such as salinity and alkalinity, temperature and diseases (Shayo *et al.*, 2006). The protein content depends on the type of rice being milled; brown rice (6-8%), white rice (6-7%) and brown rice (14%). We can see a relatively low fat content in Adan rice, which was 0.22±0.01%. Normally white rice have low fat content of ≤ 1%; as the Adan rice sample was assessed using white rice. Carbohydrate in Adan rice was high which 81.49±1.42%, while the fibre content was 5.61±0.41%. The fibre content affects the rice digestibility (WHO, 1996) where high fibre content in rice lowers its digestibility. In white rice the carbohydrate content is around 80%.

Table 5: Gelatinization Temperature of Adan rice

Sample	Spreading Observation	Alkali Digestion	Gelatinization temperature
1	Kernel swollen, collar complete and wide	Intermediate	Intermediate
2	Kernel swollen, collar	Intermediate	Intermediate

	complete and wide		
3	Kernel swollen, collar complete and wide	Intermediate	Intermediate

Adan rice has an intermediate gelatinization temperature means that the rice has intermediate time to be cooked. A higher gelatinization temperature requires longer time to cook. Environmental conditions include temperature during grain development, especially starch production influence the gelatinization temperature. A high ambient temperature during grain ripening result in starch with a higher gelatinization temperature (Cruz *et al.*, 1989).

Conclusions

The seed of Adan rice was of high quality with high purity, favorable moisture content and high germination. Adan rice has fine seed with small size, low surface area and aspect ratio. Carbohydrate was high in Adan rice and very low ash and fat contents. Intermediate gelatinization temperature indicates the time taken in cooking of white Adan rice. Information obtained from this study is useful for further research regarding the technologies to enhance the cultivation process, post harvest, storage and marketing of this traditional rice. Further research on the mechanization, storage, post harvest and marketing of Adan rice should be done for higher yield rice production.

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