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Investigation of Physico-chemical, Physical prosperties and Minerals Content in Rice (*Oryza stiva*L.)

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Abstract-The Physical and chemical prosperties and Minerals Content of18 genotypes of Rice (*Oryza stiva* L.) was done in randomized complete block design with three replications was used, Analysis of varience showed that there were high statistically significant differences at 5% level among the Physic-chemical and mineral content, and there were a significant differences in the Physical properties, Yunlu 30 is the best genotype that it gave the high value of (Fats, Ca, P, Fe, and Zn). The genotype Nerica 15 classified as the second genotype that it gave the high value of (moiture, protien, Mn and Cu) Yunlu 33 gave the best content of fiber, 100 seed weight. The WAB12 was gave the lowest value of fats and P, WAB 19 gave the lowst value of 100-seed weight. Yunlu (24, 22, 30, 26) they gave the lowest value of moisture, Ash, Carbohydrate and Mn respectively. Handao 221 gavethe lowest value of Ca and Mn. Zhonghan 3 gave the lowest grams in Fe Zn. Nerica15 had the lowest content of fiber

Index term: Rice; Genotypes; Physical properties; Physico-chemical; Minerals content

I. INTRODUCTION

Rice, *Oryza sativa* L. is the world's second most important cereal crop, grain production of rice being exceeded only by that of wheat. Rice is the major caloric source, with nearly 2.5 billion people depending on it as their main food [1]. Rice is cultivated in at least 114, mostly developing countries and is the primary source of income and employment for more than 100 million households in Asia and Africa [1]. Sine 1974 up to 1979, rice research at Gezira research station has identified many of the major constrictions to high yield in the Gezira: Environment and optimum cultural practices for the crop. However, now rice situation is well established a grain yield of 6.7 tone/ha was obtained. Despite this, the agriculture policies did not encourage its production [2].

The important factors in assessing the rice quality in amylases content is the determination of the water use pattern and maintenance of the quality of this crop [3,4,5] It suggests that amylases content is 0 to 33% in all rice cultivars [6,7]. Rice protein fractions are allergenic: glutelin, and globulin [8]. These are easily extracted from rice grain endosperm using low concentrations of NaCl [9]. In another study, rice grains pressurized at 100-400 MPa in distilled water released 0.2-2.5 mg per gram of proteins, which included globulins [10]. Rice Self pollination occurs for a very short time period, generally in the morning. Pollen grains are viable for approximately 5 minutes after emerging from the anther of the flower, thus reducing cross-pollination to less than 1% [11] and limiting pollen drift. In addition, this region may be ideal for biopharming due to strict federal requirements that pharmaceutical plants should not enter the food and commodity population [12]. Rice quality studies showed that changing amount of amylases induced differences in rice grain quality [13, 14, 15, 16]. These differences are very important in baking quality and consumers taste [17, 7]. All rice cultivars are divided to Vaxi (0% amylases) and non-Vaxi (including little amylases 10% to 20 %, 20% to 25% and rich amylases 25 to 33%, respectively) groups [18, 19, 15]. Meal amylases of rice are commercially more desirable than others due to swelling after baking; this kind also remains soft for a long time after baking and is found with less mucilage [13]. The specific objective of the study is to investigate rice quality parameters.

II. MATERIALS AND METHODS

The field experiments were conducted at Sudan University of Science and Technology (Shambat) which was located at longitude 32˚-35˚E, latitude 15˚-40˚N, and

latitude 280m above sea level. The climate of the locality is semi arid, with low relative humidity; the temperature varies between 45˚C maximum and 21˚C in summer [20]. The experiment was conducted in the period from 8th July to 25th November 2013. The soil of the experimental site (shambat) is described as loam clay. It is characterized by a deep cracking moderately alkaline with low permeability low nitrogen content and ph of 7-5.8 and a high exchange able sodium percentage (ESP) is subsoil [21]. The laboratory experiment was Carried out at Food Research Center, Khartoum North (Shambat) 2014. The plant material used in this study, includes 18 rice genotypes; 7 NERICA genotypes from WARDA (West African Rice Development Association, Benin) Named as (N4, N2, N15, N5, N17, N14, N12), 5YUNLU genotypes from China they named as (Y22, Y33, Y30, Y24, Y26) and 6 genotypes (HANDAO 221, HANDAO 502, ZHONGHAN 3) from IRRI (International Rice

Research Institute, Philippines). The material was provided by the Agricultural Research Corporation (ARC), Sudan.

The soilwas deep ploughed, harrowed two times and leveled to prepare the experimental areas, then it was divides to 54 plots for three replications, the plot size was 2×3 m^2, Weeding was controlled manually every two weeks to avoid competition of weeds .The phosphorous was applied in form of triple super phosphate (P_2O_5) as a basal dose in rate of 50kg/fed at the same day of sowing for both of the experiments, the Nitrogen in form of Urea (46% N) was applied in two equal split doses, in rate of 80kg/fed, the first one 40kg/fed after one month from sowing date, the second one after two months from sowing in the same rate. The irrigation was applied two times a week to avoid stress. Seeds were sown manually on 8th July 2013, each hole was consisted of 3-4. Seeds in depth of 3-4 cm then thinned leave two plants per hole after two weeks from the sowing.

Quality procedure

Physico-chemical analysis

Physico-chemical analyses were carried out according to methods described in AACC [22] The moisture content at 105°C/12h, Crude protein was determined by the Kjeldhal's method (N × 5.95), as well as ash content at 550°C/5h, Crude fat in Soxhlet apparatus [22]. Available carbohydrate was calculated by subtracting the sum of fat, protein, fiber and ash as a percentage from 100 as described by [23]

Physical properties

Include colour, Granule size (mm), 100seeds weight, and Taste.

The granules size of rice seeds were recorded using vernier calipers (model: E H B Stainless, Hardenend, Germany).

Mineral profile

The mineral content included Ca, P, Zn, Mn and Cu; the samples were extracted and determined by atomic absorption spectrophotometer (model: Instrument shimadzu – AA – 6800) according to method given in AOAC [24].

Statistical analysis

The field experiment was conducted in Randomized Complete Plock Design (RCBD).

Analysis of variance and the least significant difference (LSD) was processed using the M-STAT Computer programme:

$$LSD = \sqrt{\frac{2 \times EMS}{r}} \cdot t.value$$

III. RESULTS AND DISCUSSION

Physico-chemical properties

Analysis of Variance for Physico-chemical showed that there were high statistically significant differences between the genotypes in moisture, protein, Fiber, fats, Ash, and Carbohydrate according to M-stat programme table (1). The least significant difference test at 5% level showed that the Nerica's genotypes gave the highest level more than Yunlu's genotypes. Followed by WAB genotypes. Handao and Zhonghan genotypes are not marked in the high leveling genotypes. The genotypes of Yulnu gave the lowest level in physic-chemical parameters. Nerica 15 was indicated the highest percentage of Moisture and protein of (9.153, 8.323 %) respectively table (2). Followed by Nerica 5 that gave

the heist percentage of Ash (1.147 %) table (2). Yulu (33, 30) gave the highest percentage of Fibers and Fats (5.480, 2.357%) respectively, table (2). This result is agreed with the result by [25] that the Nerica's genotypes Contains 2% more protein than other Rice genotypes. WAB12 and Yulu (24, 22, 30) gave the lowest level of physic-chemical parameters of Fats (0.326) and (moisture, ash and carbohydrate) of (6.513, 0.5033, 85.20%) respectively table (2). Handao502 had the lowest percentage of Protein (6.197%). Table (2) WAB12 had the lowest level of Fats (0.326%), table (2) This might be due to the genetic differences between the genotypes

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Table (1). Summary of ANOVA table for physic-chemical properties (2013)

Source	**D.F**	**F. Value**						
		Moisture %	**Protein %**	**Fiber %**	**Fats %**	**Ash %**	**Carbo-Hydrate %**	**Physical properties (100seed weight(gm))**
Replication	2	1.352	0.796	1.27	0.1948	1.95	1.7691	0.3418
Variety	17	1005.250**	178.74**	841.57**	4165.59**	629.68**	121.27**	1.8785*
Error	34	_	_	_	_	_	_	_
Total	53	_	_	_	_	_	_	_
EMS	_	0.001	0.005	0.003	0.000	0.000	0.022	0.105
C.V%	_	0.41	1.04	1.21	2.26	1.86	0.17	15.67
SE±	_	0.0081	0.017	0.012	0.004	0.0032	0.0348	0.0762

*significant **=High Significant NS=Not Significant

Table (2). Quality Character for the mean of the different Genotypes (2013)

Genotypes	Moisture	Protein	Fiber	Fats	Ash	Carbo-hydrate
WAB 12	8.500 **J**	6.497**K**	4.130 **I**	0.327 **N**	0.553 **K**	88.360 **C**
NERICA 2	9.140 **B**	6.720 **J**	5.023 **D**	0.383 **K**	0.613 **J**	87.260**HI**
YULU 26	8.463 **K**	6.823 **I**	3.770 **M**	0.400 **J**	0.647 **I**	88.390 **D**
WAB 19	8.730 **F**	7.027 **G**	4.033 **J**	0.413 **I**	0.553 **K**	87.973 **E**
Zhonghan3	8.520 **I**	6.323 **O**	5.020 **D**	0.350 **M**	0.713 **G**	87.593 **F**
Handao221	8.767 **E**	7.240 **E**	4.553 **E**	0.363 **L**	0.503 **M**	87.340 **G**
NERICA15	9.153 **A**	8.323 **A**	2.430 **Q**	1.557 **D**	0.760 **F**	86.930 **K**
YULU 22	8.783 **D**	6.433 **M**	5.340 **B**	0.427 **H**	0.503 **M**	87.297**GH**
Handao502	8.650 **G**	6.197 **P**	3.807 **L**	1.573 **C**	1.087 **B**	87.337 **G**
YULU 33	8.623 **H**	6.480**KL**	5.480 **A**	0.473 **J**	0.533 **L**	87.023**J**
WAB 8	8.447 **L**	6.923 **H**	2.813 **P**	0.503 **F**	0.560 **K**	89.200 **A**
NERICA17	8.883 **C**	6.403 **N**	3.560 **N**	0.407 **IJ**	0.673 **H**	88.957 **B**
NERICA 5	8.893 **C**	7.317 **D**	4.437 **F**	0.357**LM**	1.147 **A**	86.743 **L**
NERICA14	8.493 **J**	7.763**B**	3.317 **O**	1.810 **B**	0.713 **G**	86.730 **L**
YULU 30	7.587 **O**	7.107 **F**	4.403 **G**	2.357 **A**	0.930 **C**	85.203**M**
YULU 24	6.513 **P**	7.433 **C**	4.290 **H**	0.367**L**	0.703 **G**	87.207**I**
NERICA12	7.727 **N**	6.457**LM**	5.303 **C**	0.347 **M**	0.903 **D**	87.007 **J**
NERICA4	8.197 **M**	6.930 **H**	3.977 **K**	1.240 **E**	0.843 **E**	87.010 **J**

Means with the same letter for parameters are not significant at 5% level (LSD)

Physical properties

There was a statistically significant different at the 5% level in the 100 seed weight, table (1). There was a different in the color among testing genotypes, Nerica (2, 5, 12), Yunlu (22, 26, 33), WAB (12, 8) and Zhonghan3 their color is Beige. Nerica 15 and Yunlu30their color is Brown. Handao221 and Yunlu24 their color is white. WAB 19 has a golden color. Handao502 is Beige to Brown, Nerica 17 is Greenish beige, Nerica14 is Brown to beige, Nerica4 is Brown, Gray, beige (table 3).Yunlu33 gave the highest weight in 100 seeds (2.733

gm), (table 3). While WAB19 gave the lowest weight of (1.667 gm). Which affected the Yield of Rice. A result is disagreeing with [26] indicated that Nerica's varieties were higher yielding genotypes under irrigated condition.Nerica (17, 5, 12, 4), Yulu (22, 33, 30, 24)

WAB (12, 19), Zhonghan3 and Handao502 gave the most desirable taste, while Nerica (2, 14) Yulu 26, handao221, WAB 8 gave the normal taste. Nerica 15 is off taste table (3)

Table (3). Physical Prosperities for the different genotype

Variety	Color	Granule size(mm) *	100 seeds weight(gm)	Taste **
WAB 12	Beige	6.0x2.0x2.0	2.00	5
NERICA 2	Beige	7.0x2.0x1.8	2.1	4
YULU 26	Beige	5.0x3.0x2.0	2.1	4
WAB 19	Golden	7.0x3.0x1.0	1.7	5
Zhonghan 3	Beige	7.0x2.0x1.9	2.2	5
Handao 221	White	6.0x2.0x1.0	2.1	4
NERICA 15	Brown	7.0x2.0x1.5	2	2
YULU 22	Beige	7.0x2.0x2.2	2.1	5
Handao 502	Beige to Brown	5.0x2.0x1.6	1.9	5
YULU 33	Beige	7.0x2.0x2.0	2.7	5
WAB 8	Beige	7.0x2.0x2.0	1.7	4
NERICA 17	Greenish Beige	7.0x2.0x1.5	2.0	5
NERICA 5	Beige	7.0x2.0x2.0	2.5	5
NERICA 14	Brown to beige	7.0x2.0x1.6	2.2	4
YULU 30	Brown	5.0x2.5x2.0	2.0	5
YULU 24	White	8.0x2.5x2.0	1.9	5
NERICA 12	Beige	6.0x3.0x2.0	1.8	5
NERICA 4	Brown, gray, beige	6.1x2.1x2.0	2.2	5

*Length x width x thickness **5: Desirable, 4-3: Normal, 2-1: Off taste

Mineral Content mg/100g

There were high statistically significant differences among the mineral content in the Rice genotypes table (4). Yunlu 30 had the highest content of Ca and P, Fe and Zn of (62.57, 449.3, 4.297, and 4.163 mg) respectively table (5). Nreica 15 had the highest content of Mn and Cu (5.827 and 1.827 mg) respectively. table (5).

Handao221 had the lowest content of Ca (27.36 mg) and Mn (0.513 mg) Chart (4, 5). AWB 12 had a lowest content of P (9367 mg) Table (5) Zhonghan 3 gave the lowest content of Fe and Zn (0.806 and 0.72 mg) respectively.

Table (4).summary of ANOVA table for minerals 'content properties (2013)

Source	**D.F**	**F. Value**					
		Ca	**P**	**Fe**	**Zn**	**Mn**	**Cu**
Replication	2	0.88	0.779	1.085	0.894	1.0882	5.475
Variety	17	39441.4**	2842.73**	11.2824**	3299.99**	9289.5**	5344.4**
Error	34	_	_	_	_	_	_
Total	53	_	_	_	_	_	_
EMS	_	0.006	10.143	0.174	0.001	0.001	0.000
C.V%	_	0.16	1.57	20.22	1.41	1.60	1.85
SE±	_	0.0177	0.750	0.098	0.0071	0.0075	0.0028

*significant **=High Significant NS=Not Significant

Table (5). Mineral Profile for the mean of the different Genotypes (2013)

Genotypes	Ca	P	Fe	Zn	Mn	Cu
WAB 12	40.160 **P**	93.667 **P**	1.313 **H**	1.297 **M**	0.927 **K**	0.257 **M**
NERICA 2	45.287 **K**	118.667 **M**	2.117 **E**	1.563 **K**	0.737 **P**	0.307 **L**
YULU 26	42.587 **M**	126.667 **L**	1.653 **G**	1.887 **F**	0.830 **M**	0.193 **O**
WAB 19	50.637 **F**	108.667 **N**	1.227 **H**	1.640 **J**	0.633 **Q**	0.217 **N**
Zhonghan3	38.807 **Q**	105.000 **O**	0.807 **I**	0.720 **N**	0.813 **N**	0.353 **J**
Handao221	27.363 **R**	94.667 **P**	2.357 **D**	1.547 **L**	0.513 **R**	0.423 **H**
NERICA15	60.037 **B**	347.667 **B**	3.147 **B**	3.937 **B**	5.827 **A**	1.827 **A**
YULU 22	45.700 **J**	173.000 **K**	1.923 **F**	2.703 **E**	2.657 **F**	0.323 **K**
Handao502	55.617 **D**	292.333 **D**	2.293 **D**	2.950 **D**	3.690 **D**	1.217 **C**
YULU 33	46.587 **I**	200.000 **H**	1.180 **H**	1.633 **J**	1.023 **J**	0.403 **I**
WAB 8	40.683 **N**	229.000 **F**	2.017 **EF**	1.290 **M**	1.120 **G**	0.397 **I**
NERICA17	51.507 **E**	191.667 **I**	2.113 **E**	1.653 **I**	1.107 **H**	0.443 **G**
NERICA 5	49.877 **G**	174.667 **J**	1.867 **F**	1.790 **G**	1.053 **I**	0.363 **J**
NERICA14	57.613 **C**	311.667 **C**	1.553 **G**	3.823 **C**	4.733 **C**	1.207 **C**
YULU 30	62.570 **A**	449.333 **A**	4.297 **A**	4.163 **A**	5.207 **B**	1.687 **B**
YULU 24	40.597 **O**	262.333 **E**	2.713 **C**	1.683 **H**	0.873 **L**	0.613 **E**
NERICA12	43.237 **L**	174.333 **J**	1.973 **EF**	1.543 **L**	0.753 **O**	0.513 **F**
NERICA4	47.940 **H**	203.000 **G**	2.610 **C**	2.697 **E**	3.073 **E**	0.843 **D**

Means with the same letter or parameters are not significant at 5% level (LSD)

IV. CONCLUSION

Yunlu's genotypes were the highest level on the Quality of rice more than Nerica's and WAB genotypes. Yunlu 30 identified as the best genotype, that because it's a major source in Fats, Ca and P, Fe and Zn content. while the WAB12,Handao 221, and Zhonghan 3 they had the lowest value of (Fat, P) , (Ca, Mn) and (Fe, Zn) respectively .

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