EFFECT OF GERMINATION CONDITIONS ON PROXIMATE CHEMICAL COMPOSITION OF SOME PAKISTANI BROWN AND POLISHED RICE VARIETIES

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Five Pakistani rice varieties namely Basmati Super, Basmati 385, Basmati 2000, Irri-6 and Irri-9 were analyzed for proximate chemical composition such as moisture, total crude protein, crude fiber, crude fat, ash and carbohydrates when the rice varieties are in brown and polished forms and then these varieties were subjected to undergo germination process and analyzed the proximate chemical composition at different intervals of germination. First, all the varieties were kept in the same environmental conditions for control analysis and there was no significant difference found in moisture in these varieties whereas there was a significant difference in protein percentage, fiber percentage, fat percentage ash content percentage, and carbohydrates percentage among the all varieties.

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SUMMARY

Five Pakistani rice varieties namely Basmati Super, Basmati 385, Basmati 2000, Irri-6 and Irri-9 were analyzed for proximate chemical composition such as moisture, total crude protein, crude fiber, crude fat, ash and carbohydrates when the rice varieties are in brown and polished forms and then these varieties were subjected to undergo germination process and analyzed the proximate chemical composition at different intervals of germination. First, all the varieties were kept in the same environmental conditions for control analysis and there was no significant difference found in moisture in these varieties whereas there was a significant difference in protein percentage, fiber percentage, fat percentage ash content percentage, and carbohydrates percentage among the all varieties. The protein percentage varies from 6.22 to 8.24 in polished rice varieties and varies from 7.14 to 8.95 in brown varieties. Similarly the fat content also varied from 5.04 to 5.48 in polished varieties and 5.56 to 6.78 in brown varieties. The carbohydrate content in polished rice varieties varied from 72.88 to 76.03 and in brown varieties it varied from 65.37 to 67.22. This study is helpful as a digest chemical composition of rice varieties before and after polishing. The results of this study will be helpful for the rice consumers to choose the rice variety for their daily use. Irri-6 must be given more attention by the rice breeders to use in their hybridization programs as these varieties exhibit more proteins and minerals which are required to maintain normal body metabolism whereas Basmati rice varieties are good in fat and carbohydrates which shown to be the superior variety among the all.

After the rice varieties being germinated; their proximate chemical composition analyzed on dry basis and found random difference in moisture which always depends on the surroundings conditions where as slight decrease in protein content, fat content found as the germination time of rice increases both in polished and brown forms. On other hand ash content and fiber content shown slight increase with increase of germination time in both conditions.

The aim of this study is to compare the Pakistani rice varieties in international market with respect to chemical composition to compete the international market with its high quality and chemical composition and to investigate the change in chemical compositions during the germination and to present a comparative analysis of chemical composition of controlled and germinated rice varieties in both polished and brown conditions.

INTRODUCTION

Rice is one of the most important cereals used by human being in the world and almost half of the world's population depends on rice as the main food source [1]. Rice is cultivated in over 110 countries around the world and is a staple food for the major world population. The total rice paddy production area is more than about 154 million hectare and the annual production of rice is more than about 594 million tons. According to the economic survey of Pakistan total land used for rice production in the economic year 2011-12 is 2571 thousand Hectares which is an increase of 8.7% that of 2365 thousand hectare of economic year 2010-11. The production of rice in Pakistan in economic year 2011-12 is 6160 thousand tons which is an increase of 27.7% that of 4823 thousand tons production of economic year 2010-11[2] Rice contributes over 22% of global energy intake. While the production and consumption of rice are concentrated in Asia, which accounts for about 92% of the world's total production [3], rice is also an important crop in specific regions of North and South America, Africa and Europe [4].

Rice being the major staple food in the world is one of the cheapest and major sources of food energy and protein. Brown rice contains nutritional components, such as dietary fibers, essential amino acids, minerals, proteins, vitamin B and E and other non-nutrient essential phytochemicals, concentrated in the germ and outer layers of the starchy endosperm, which are removed as rice bran during whitening or milling operation [5]. Rice bran is also a rich source of protein with dual benefits of being plenteous and economical [6] which is generally isolated by wet alkaline extraction or with the aid of physical processing or enzymatic treatment [7] that is not a part of this study. Rice has been considered as the queen among cereals for its nutritional quality and higher digestibility in the world [8]. In Pakistan two types of rice i.e. coarse and fine varieties are grown. Although rice is low in riboflavin and thiamine (vitamin) but its carbohydrate and protein percentage available is sufficient to sustain the energy needs for an adult whereas, for growing children, rice needs to be supplemented by other protein sources [9]. Therefore most of the rice derivatives are prepared for adult formulation rather than infant formulation the other factor for doing so is relatively higher content of fiber in rice than the other cereals. The fine varieties of rice possess a specific aroma characteristic and cooking characteristics due to which these are very much liked all over the world and achieve higher price in the market.

The study has been designed to assess the chemical composition of rice varieties grown in Pakistan and to compare these compositions difference in polished and brown rice samples of the same varieties and the change in composition during different intervals of germination conditions.

RESULTS AND DISCUSSIONS

The analysis indicates that the moisture content is not much varying in the different varieties when they are in the form of polished or unpolished with identical conditions. The moisture content is found higher in brown varieties polished forms. The rice samples contained high quantities of carbohydrates ranging from 75.51 to 77.14 is Basmati Supper with mean carbohydrate value 76.03 and brown variety has lower carbohydrates content as compared to the polished varieties and its mean valve is 67.22. As in polished condition the variety has high level of carbohydrates and low level of proteins (i.e. 6.22%) Basmati Rice is good for cooking purpose. Whereas the highest protein percentage found in Irri-6 which is 8.24% and the carbohydrate level is lower in this Variety (i.e.72.88%). Percentage of ash content varies from lowest level 1.44% in Basmati Supper to highest level of 2.46% in Irri-9 whereas fat content is higher in Basmati Supper 4.08% and lowest is in Irri-6 (i.e. 3.64%). Fiber content also slightly varies in all varieties from 1.18% (lowest in basmati supper) to highest 1.74% (in Irri-9)

The difference of chemical composition is almost similar in brown samples and polished samples of the same rice varieties i.e. high carbohydrate high fat and low protein in Brown Basmati sample and highest protein found in brown Irri-6 while highest Fiber content found in Brown Irri-9. During the germination process fat and protein content increases gradually with increase of soaking time whereas ash and fiber content increases gradually with increase of germination intervals as shown in table "A" and "B".

EXPRIMENTAL

Sample Collection

Rice varieties were collected with thanks from "Rice Exporters Association of Pakistan" (REAP). The varieties were collected from one of the batches of harvested year 2011; both polished and brown samples are taken from same variety.

Reagents

All the reagents used in this study were Analytical Grade and obtained from MERCK (Merck KGaA, Darmstadt, Germany) and SIGMA-ALDRICH (Sigma Aldrich Tokyo Japan Branch).

DETERMINATION OF PROXIMATE CHEMICAL COMPOSITION

Moisture

The determination of moisture content (110ºC/4hr) described by standard official method of analysis of the AOAC Eighteenth edition (2005) revision (2010) [10].

Crude Protein

Crude protein by nitrogen determination using the Kjeldhal's method (N x 5.95) AOAC Eighteenth edition (2005) revision (2010) [11].

Crude Fat

Crude fat of all the varieties was extracted by Soxhlet apparatus (solvent CCl_4) AOAC Eighteenth edition (2005) revision (2010) [12].

Crude Fiber

Crude fiber was carried out by digesting the de-fated samples of all varieties in 1.25% H_2SO_4 followed by 1.25% NaOH solutions according to their respective method given in AOAC Eighteenth edition (2005) revision (2010) [13]

Ash

Ash content of each sample was determined by taking 5g sample and placing it in Muffle Furnace at 600ºC for 3hrs after ignition at open flame. AOAC Eighteenth edition (2005) revision (2010) [14].

NFE

Nitrogen free extract (NFE) or The total percentage of starch (carbohydrates) content was determined by subtracting the contents of moisture, protein, ash, fat and fiber from 100; the standard method of analysis of the AOAC Eighteenth edition (2005) revision (2010).

Germination of Rice Seeds

Germination is the process in which a plant or fungus emerges from a seed or spore and begins growth. Germination is the growth of an embryonic plant contained within a seed; it results in the formation of the seedling. In this study germination carried out by the method used by Suchada Maisont and Woatthichai Narkrugsa [15] with some modifications i.e. 500g of rice was soaked in 2 Letter of water and at 28^0C for 96 hours and water changed after each 24 hrs; each rice variety placed in separate container but in same environmental conditions and samples for

analysis of chemical compositions were drawn after 6, 12, 24, 36, 48, 60, 72 and 96 hrs. The analysis carried out in five analyses for each sample.

Statistical Analysis

Five replicates of each variety were analyzed and the data generated was subjected to statistical analysis using analysis of standard deviation. MS.Excell-2007 used for preparation of all the tables, calculation of means and standard deviations of replicate analysis.

The data given two tables "A" and "B" is the mean of each variety which tested in five replicate analyses.

CONCLUSION

This study indicates the significant variation of proximate composition among the rice varieties examined in polished and non-polished forms and it also

The comparative data received after several analyses; indicates that the proximate parameters such as crude protein, crude fiber, ash, crude fat in brown rice varieties are higher than the polished rice varieties. This means that the above parameters are reduced in polished rice during the polishing procedure and the polishing or bran of rice varieties become rich in above parameters i.e. crude protein from 11% to 13%, crude fiber from 7.6% to15.15%, crude fat from 9.5 to 14.07%, ash from 9.8% to 17.15% [16-20]. During the different intervals of soaking the rice varieties subjected to analyzed the chemical compositions and slight difference has been found in moisture and Carbohydrate content or NFE% but in random; whereas continuous increase found in fiber percentage and Ash percentage with increase of soaking of rice seeds on other hand protein percentage and fat percentage seems to be reduced continuously with increasing soaking time which is may be due to the washing of rice seeds during water change.

In sort; the result of this study can be exploited by rice consumers in their choices regarding above chemical compositions and also for soaking time before cooking purpose because chemical compositions slightly changes during germination also increase of some minerals may be better for consumers' health. Basmati supper rice variety was observed to be superior in percentage carbohydrate and irri-6 is superior in percentage nitrogen, or protein contents among other varieties studied. On the basis of above results we can say that the Pakistani Rice varieties should get more attentions in terms of proximate and chemical compositions in international market.

Table. A: Chemical Composition of Polished Rice varieties in controlled and Germinated Conditions

All values are expressed as mean **+** standard deviation (n=5)

Variety	Ingredients	Controlled	12G/Hrs	24G/Hrs	36G/Hrs	48G/Hrs	60G/Hrs	72G/Hrs	96G/Hrs
Basmati Supper	Moisture%(±0.14)	11.05	11.11	11.08	11.12	11.15	11.09	11.014	11.07
	Protein% (±0.12)	6.22	6.21	6.19	6.15	6.12	6.09	6.05	6.02
	Ash% (±0.07)	1.44	1.46	1.48	1.49	1.49	1.51	1.53	1.55
	Fiber% (±0.08)	1.18	1.19	1.21	1.22	1.22	1.24	1.26	1.27
	Fat% (±0.13)	4.08	4.05	4.06	4.01	4.39	4.38	4.36	4.32
	NFE% (±0.22)	76.03	75.98	75.98	76.01	75.63	75.69	75.786	75.77
Basmati -385	Moisture%(±0.14)	11.08	11.08	11.12	11.06	11.14	11.12	11.13	11.05
	Protein% (±0.12)	6.65	6.64	6.61	6.58	6.55	6.54	6.51	6.49
	Ash% (±0.07)	2.02	2.05	2.06	2.08	2.11	2.13	2.15	2.18
	Fiber% (±0.08)	1.52	1.56	1.58	1.61	1.64	1.66	1.68	1.72
	Fat% (±0.13)	3.98	3.96	3.96	3.94	3.91	3.89	3.85	3.81
	NFE% (±0.22)	74.75	74.71	74.67	74.73	74.65	74.66	74.68	74.75
Basmati-2000	Moisture%(±0.14)	11.06	11.09	11.12	11.03	10.98	11.12	11.02	11.15
	Protein% (±0.12)	6.84	6.81	6.78	6.75	6.74	6.71	6.69	6.65
	Ash% (±0.07)	2.44	2.45	2.48	2.48	2.51	2.53	2.53	2.55
	Fiber% (±0.08)	1.68	1.69	1.72	1.74	1.75	1.77	1.79	1.82
	Fat% (±0.13)	3.64	3.62	3.58	3.54	3.51	3.49	3.45	3.42
	NFE% (±0.22)	74.34	74.34	74.32	74.46	74.51	74.38	74.52	74.41
Irri-6	Moisture%(±0.14)	11.12	11.09	11.16	11.21	11.24	11.18	11.15	11.07
	Protein% (±0.12)	8.24	8.22	8.19	8.15	8.13	8.09	8.05	8.03
	Ash% (±0.07)	2.44	2.45	2.48	2.51	2.52	2.55	2.57	2.59
	Fiber% (±0.08)	1.68	1.69	1.72	1.75	1.76	1.78	1.81	1.84
	Fat% (±0.13)	3.64	3.62	3.61	3.57	3.55	3.51	3.49	3.46
	NFE% (±0.22)	72.88	72.93	72.84	72.81	72.8	72.89	72.93	73.01
Irri-9	Moisture%(±0.14)	11.24	11.09	11.24	11.32	11.16	11.27	11.23	11.31
	Protein% (±0.12)	7.65	7.62	7.57	7.55	7.51	7.48	7.44	7.41
	Ash% (±0.07)	2.46	2.47	2.48	2.52	2.55	2.56	2.59	2.62
	Fiber% (±0.08)	1.74	1.76	1.77	1.79	1.82	1.85	1.87	1.89
	Fat% (±0.13)	3.75	3.71	3.69	3.68	3.65	3.61	3.58	3.56
	NFE% (±0.22)	73.16	73.35	73.25	73.14	73.31	73.23	73.29	73.21

Data shown above are the percentages of chemical composition of Polished rice varieties on dry basis.
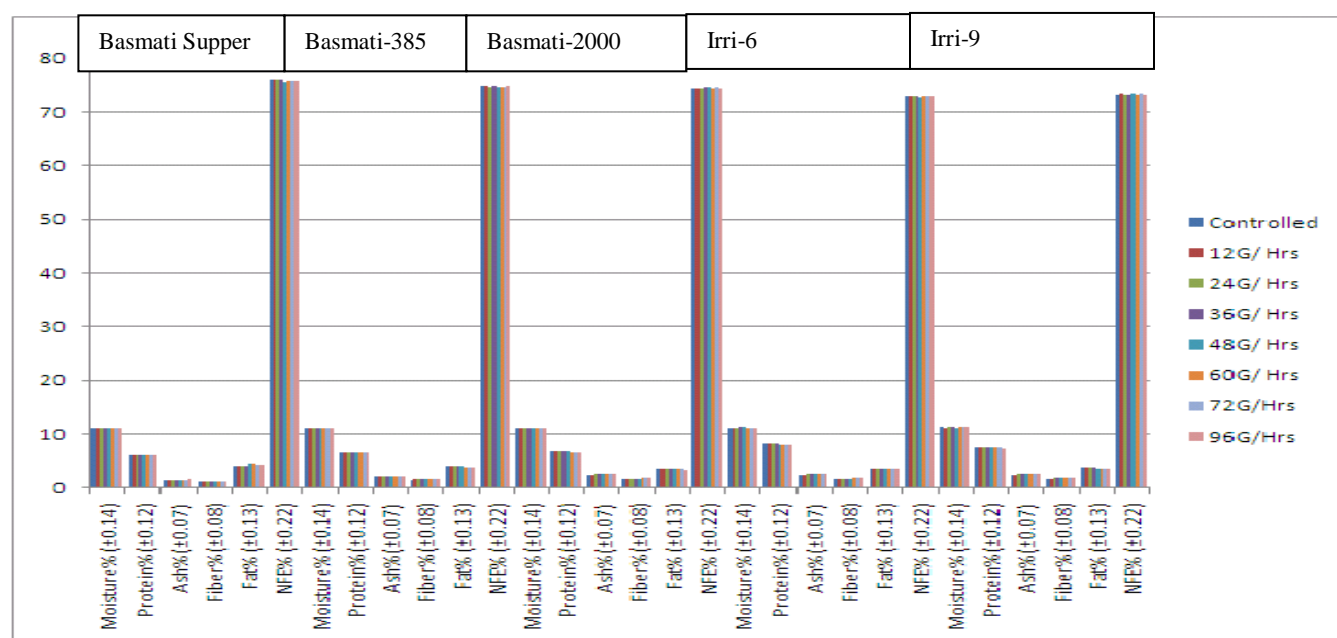
Diagram 1. (Chart presentation of proximate chemical composition of Pakistani Polished Rice Varities in controlled and germination conditions)

Table. B: Chemical Composition of Brown Rice varieties in controlled and Germinated Conditions

All values are expressed as mean ± standard deviation (n=5)

Variety	Ingredients	Controlled	12G/Hrs	24G/Hrs	36G/Hrs	48G/Hrs	60G/Hrs	72G/Hrs	96G/Hrs
Basmati Supper	Moisture%(±0.14)	12.04	12.45	11.87	12.35	12.55	12.03	12.25	12.58
	Protein% (±0.12)	7.14	7.09	7.02	6.94	6.88	6.56	6.44	6.28
	Ash% (±0.07)	3.58	3.61	3.63	3.65	3.68	3.67	3.69	3.73
	Fiber% (±0.08)	3.24	3.34	3.35	3.37	3.39	3.41	3.42	3.45
	Fat% (±0.13)	6.78	6.65	6.36	6.25	6.21	6.18	6.14	6.05
	NFE% (±0.22)	67.22	66.86	67.77	67.44	67.29	68.15	68.06	67.91
Basmati -385	Moisture%(±0.14)	12.11	12.08	12.22	12.28	12.16	12.25	12.28	12.16
	Protein% (±0.12)	8.01	7.98	7.86	7.69	7.64	7.61	7.58	7.55
	Ash% (±0.07)	3.76	3.78	3.79	3.81	3.85	3.86	3.88	3.89
	Fiber% (±0.08)	3.84	3.85	3.88	3.89	3.91	3.94	3.96	3.97
	Fat% (±0.13)	6.02	5.99	5.97	5.96	5.92	5.91	5.88	5.86
	NFE% (±0.22)	66.26	66.32	66.28	66.37	66.52	66.43	66.42	66.57
Basmati-2000	Moisture (±0.14)	12.08	12.11	12.09	12.05	12.12	12.25	12.23	12.31
	Protein% (±0.12)	8.05	8.02	8.01	7.98	7.89	7.88	7.84	7.81
	Ash% (±0.07)	3.73	3.74	3.74	3.76	3.79	3.81	3.82	3.84
	Fiber% (±0.08)	3.86	3.88	3.89	3.89	3.91	3.92	3.93	3.95
	Fat% (±0.13)	5.98	5.96	5.93	5.91	5.91	5.87	5.85	5.84
	NFE% (±0.22)	66.3	66.29	66.34	66.41	66.38	66.27	66.33	66.25
Irri-6	Moisture%(±0.14)	12.12	12.22	12.09	12.15	12.19	12.16	12.24	12.26
	Protein% (±0.12)	8.95	8.84	8.86	8.85	8.82	8.79	8.76	8.73
	Ash% (±0.07)	3.94	3.94	3.95	3.97	3.99	3.41	3.42	3.44
	Fiber% (±0.08)	4.06	4.08	4.09	4.11	4.12	4.15	4.16	4.18
	Fat% (±0.13)	5.56	5.52	5.51	5.48	5.46	5.44	5.43	5.41
	NFE% (±0.22)	65.37	65.4	65.5	65.44	65.42	66.05	65.99	65.98
Irri-9	Moisture%(±0.14)	12.34	12.35	12.28	12.09	12.34	12.36	12.38	12.29
	Protein% (±0.12)	8.65	8.64	8.62	8.61	8.57	8.56	8.54	8.51
	Ash% (±0.07)	3.98	3.99	3.41	3.43	3.45	3.46	3.48	3.49
	Fiber% (±0.08)	4.34	4.35	4.36	4.38	4.38	4.39	4.41	4.43
	Fat% (±0.13)	5.74	5.71	5.69	5.68	5.64	5.62	5.61	5.59
	NFE% (±0.22)	65.55	64.96	65.64	65.81	65.62	65.61	65.58	65.69

Data shown above are the percentages of chemical composition of brown rice varieties on dry basis.
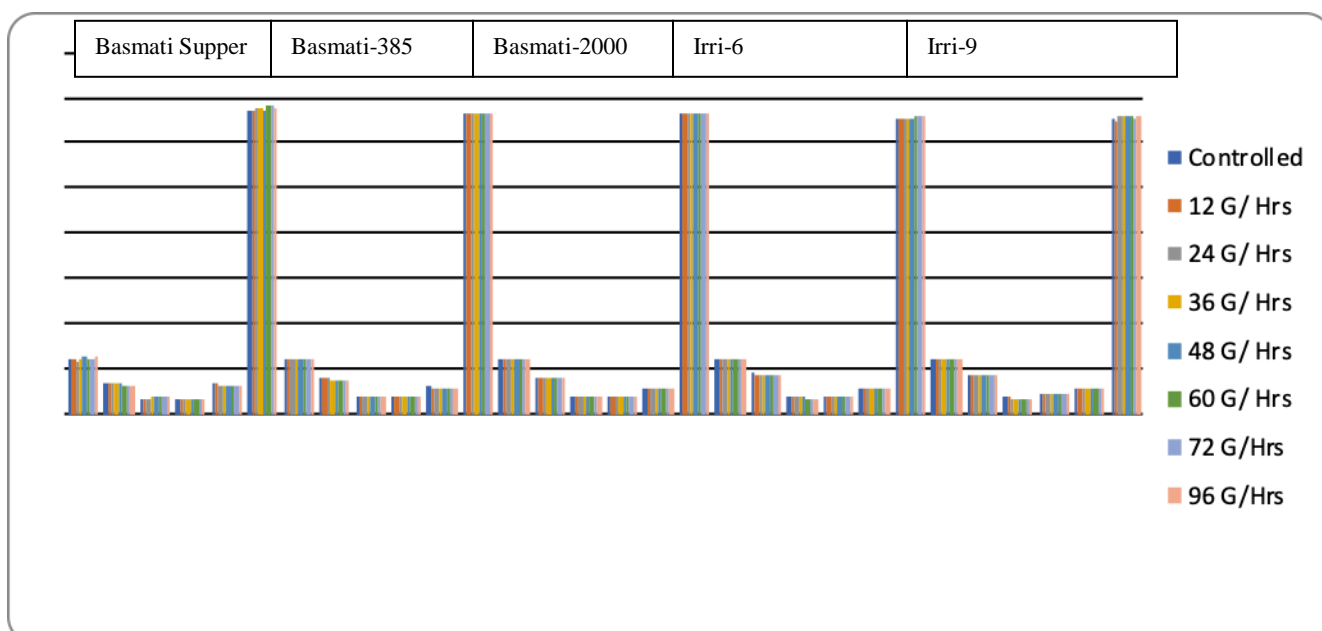
Diagram 2. (Chart presentation of proximate chemical composition of Pakistani Brown Rice Varities in controlled and germination conditions)

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