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Original Research Article

Nutritional Composition Analysis of Improved and Released Rice Varieties in Ethiopia

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ABSTRACT

The nutritional composition of ten improved and released rice varieties collected from different research centers in Ethiopia were analysed in Assosa agricultural and nutritional research laboratory. The percent of moisture, ash, crude fat, crude protein, crude fiber, carbohydrate and total energy were 9.78-11.93%, 0.62-1.63%, 1.14-2.57%, 8.41-11.77%, 1.58-3.38%, 74.96-78.03% and 365.35-376.92 kcal $(100g)^{-1}$ respectively. The analysis of variance shows that the proximate compositions of most rice varieties are significantly different ($p < 0.05$). Pawe-1 rice variety has good source of protein and total energy. On the other hand, TANA rich in carbohydrate content, Kokit is a good source of fat and SUPARICA-1 rich in crude fiber relative to improved and released rice varieties studied. Therefore, End users can be selecting these rice varieties according to the indicated percent of proximate analysis result and their preference for food formulation, nutrition and other purpose.

Keywords: crude, fiber, fat, carbohydrate, protein, ash.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the commonly consumed cereals and food staples for more than half of the world's population. [1] Rice provides 20 percent of the world's dietary energy supply. It is also a good source of thiamine, riboflavin, niacin and dietary fiber. In Asia, where 95% of the world's rice is produced and consumed; it contributes 40-80% of the calories of Asian diet. [2] Among the cereals, rice and wheat share equal importance as leading food sources for human nutrition. Rice provides 60 % of the food intake in Southeast Asia. [3] The major producers of this cereal are found in Asia i.e. China, India, and Indonesia which together account more than 50% of the world's total Production. [4] According to [5] globally its production has risen to 758.8 million tons of paddy rice. Rather than its contribution for consumption, it is a good opportunity for domestic and international market for economic development in China, India, Indonesia and USA. [6] Cereals are often reported as carbohydrate- rich foods, as they are composed of approximately 75% carbohydrate and 6-15% protein. [7] The major storage proteins in wheat are gliadins and glutenins, while in rice it is glutelin (oryzenin), in maize it is prolamin (zein); barley has hordeins and glutelins, and in oats there are albumins and globulins. [8,9] Rice has potential wide range of food categories. Besides having nutritional and medicinal benefits, by-products of rice are equally important and beneficial. The by-products are rice husks, rice bran, broken rice, rice flour, rice milk, rice pudding, rice starch, rice straw, rice beverage, rice paper, rice glue, rice cakes (mocha), rice vinegar,

rice soya milk, rice yeast and rice based food products. [2] In Ethiopia, production history of rice started let 1960. Recently, the production of rice increase as a strategic food security crop and as food crop, income source, employment opportunity, animal feed has been well recognized in Ethiopia. [10] As a result of this awareness and understanding, different researchers conducted research on yield performance variability, stability, heritability and genetic advance; identifying stable and high yielding, disease resistance; maturity time, phenotypic correlation on yield and yield component traits; the interaction of genotype with environment and related works have been studied in the past few years. [11-19] However the literature review revealed that Ethiopian improved and released rice varieties, the nutritional aspect, food composition and chemical parameter analysis had not done yet. Therefore, this study has been designed to determine the proximate composition of ten improved and released rice varieties in the country for the generation of baseline data for the next use and study.

MATERIAL AND METHODS

This experiment was conducted in Ethiopia Institute of Agricultural Research. Assosa agricultural research center in agricultural and nutritional research laboratory in Benishangul Gumuz regional state, Assosa, western Ethiopia.

Rice sample collection and preparation

The sample of ten rice varieties improved and released in Ethiopia were collected from four research centers in the country. Assosa, Pawi and Fogera Research centers from Benishangul Gumuz and Amhara regional states. The collected varieties were NERICA-12, Kallafo-1 (FOFIFA 3737), SUPARICA-1, Hidasse, ANDASSA, Kokit, TANA, GETACHEW, Edget and Pawe-1. Maximum of 600 g homogenized sample size were sampled from the respective variety independently with random fashion. The samples were milled with (miller machine), sieved with (sieve size of 1 mm diameter), after husk with mortar and pestle manually and stored with pre leveled plastic bag for the proximate analysis.

The proximate analysis

The collected rice varieties subjected to the proximate analysis of moisture content, total ash, protein, crude fat, crude fiber, carbohydrate and total energy in duplicate with official standard methods. [20, 21] Moisture content was determined by direct method (oven-dry method) as the loss in weight due to evaporation from sample at a temperature 105 ºC for about 24 hour's. The weight loss in each case represented the amount of moisture present in the sample. Moisture (%) = $\{(W1 – W2) \times W1^{-1}\} \times 100$, Where W1 = weight of original sample, W2 = weight of dried sample. The crude protein content was determined following the micro Kjeldahl method. [20] Percentage of nitrogen (N) was calculated using the following equation. Nitrogen (%) = $\{(S – B) \times N \times 0.014 \times D \times 100\} \times (\text{weight of sample} \times V)^{-1}$, Where D = Dilution factor, T = Titration value = (S – B), W = weight of sample, 0.014 = Constant value. Crude protein was obtained by multiplying the corresponding total nitrogen content by a conventional factor of 6.25. Thus crude protein (%) = % of N × 6.25. because in living organism 16% of protein composed from nitrogen. Crude fat was determined by the Soxhlet extraction technique followed by. [20, 21] Fat content of the dried samples can easily extracted into organic solvent (petroleum ether) at 40 - 600 ºC and followed to reflux for 6 h. **Percentage of fat content was calculated using the following formula.** Crude Fat (%) = Weight of fat in sample × 100 × $(\text{Weight of dry sample})^{-1}$. Ash content was determined by combusting the samples in a muffle furnace at 600ºC for 8 h according to the method. [20, 21] Ash content (%) = Weight of Ash × 100/ Weight of sample.

The bulk of roughage in food is referred to as the fiber and is called crude fiber. Milled sample was dried, defatted with ethanol acetone mixture and then the

experiment was carried out using the standard method as described in. [20, 21]

Crude Fiber (%) = (Weight of residue – weight of Ash) × 100 × (Weight of sample)$^{-1}$.

The carbohydrate content was estimated by the difference method. It was calculated by subtracting the sum of percentage of moisture, fat, protein and ash contents from 100% according to. [20, 21]

Carbohydrate (%) = 100 – (moisture% + Fat % + Protein % + Ash %).

The total energy value of the food formulation was calculated according to the method of using the formula. [22] Total energy (kcal/100g) = [(% available carbohydrates × 4.1) + (% protein × 4.1) + (% fat × 9.3)]

Statistical Methods

The analysis of variance: all the measurements were done in duplicate and reported as mean ± SD (standard deviation). The statistical analysis was done using SAS version 9.2 statistical analysis software. The percentage mean variability of the proximate composition analysis of rice varieties was done using Duncan's multiple range tests at 95% confidence level for the significance difference test.

RESULTS

Proximate Composition

In this study, the proximate composition of ten improved and released rice varieties of the percentage moisture content, ash content, crude fat, crude protein, crude fiber, carbohydrate and total energy have been presented as shown in table1.The content of moisture ranges from 9.78% (Pawe-1) to 11.93% (Kallafo-1), Ash content ranges from 0.62% (SUPARICA-1) to 1.63% (Edget), Crude fat ranges from 1.14% (SUPARICA-1) to 2.57% (Kokit), protein content ranges from 8.41% (TANA) to 11.77% (Pawe-1), crude fiber content ranged from 1.51% (Pawe-1) to 3.38% (SUPARICA-1), carbohydrate content ranges from 74.96% (Pawe-1) to 78.03% (TANA) and total energy ranges from 365.35% (Edget) to 376.92% (Pawe-1). The analysis of variance: all the measurements were done in duplicate and reported as mean ± SD (standard deviation). The statistical analysis was done using SAS version 9.2 statistical analysis software. The percentage mean variability of the proximate composition analysis of rice varieties was done using Duncan's multiple range tests at 95% confidence level for the significance difference test.

Table 1:- Improved and released rice varieties proximate composition analysis data.

Varieties	Moisture (%)	Ash (%)	Crude fat (%)	Protein (%)	Crude fiber (%)	Carbohydrate (%)	Energy kcal (100g)$^{-1}$
NERICA-12	11.67±0.035	0.96±0.018	1.56±0.028	10.762±0.478	3.11±0.156	75.05±0.520	366.35±4.354
Kallafo-1	11.93±0.123	1.20±0.007	1.83±0.2	9.75±0.001	2.06±0.084	75.30±0.07	366.21±2.277
SUPARICA-1	11.35±0.454	0.62±0.074	1.14±0.168	9.58±0.237	3.38±0.169	77.30±0.458	366.83±2.473
Hidasse	11.64±0.314	0.86±0.015	1.57±0.064	10.26±0.236	2.46±0.057	75.68±0.603	366.89±4.033
ANDASSA	11.44±1.268	0.80±0.033	1.231±0.154	9.41±0.475	2.06±0.085	76.98±2.121	365.66±5.325
Kokit	10.25±0.015	1.51±0.015	2.57±0.094	10.59±0.238	1.99±0.014	75.08±0.176	375.12±0.825
TANA	11.09±0.081	1.00±0.000	1.47±0.223	8.41±0.003	2.94±0.085	78.03±0.147	368.09±2.693
GETACHEW	10.75±0.097	1.42±0.068	1.80±0.014	8.57±0.714	1.99±0.01414	77.45±0.892	369.46±6.718
Edget	11.44±0.505	1.63±0.015	1.72±0.200	8.91±0.240	2.50±0.007	76.30±0.524	365.35±1.271
Pawe-1	9.78±0.188	1.20±0.032	2.30±0.051	11.77±0.950	1.58±0.106	74.96±0.744	376.92±0.369
Mean	11.13	1.12	1.72	9.80	2.41	76.21	368.689
Cv	4.246	3.252	8.193	4.667	3.932	1.099	0.976
P <0.05	0.0185	<0.0001	<0.0001	0.0005	<0.0001	0.0249	0.0805

DISCUSSION

The highest percent of protein, total energy and the lowest percentage of moisture, crude fiber and carbohydrate were observed in Pawe-1 rice variety. The analysis of variance in the proximate composition using Duncan's multiple range tests shows that kallafo-1 with GETACHEW, Kokit and Pawe-1; NERICA-12 with Kokit and Pawe-1; SUPARICA-1 with Pawe-1 significantly different in the moisture contents. In the ash content Pawe-1 and Kallafo-1; TANA and NERICA-12; Hidasse and ANDASSA are

not significantly different. The other rice varieties are significantly different with each other in the ash contents. In the crude fat content Kokit and Pawe-1 are significantly different from other eight rice varieties. But there is no significant difference between Kokit and Pawe-1 in the fat content. Pawe-1 and NERICA-12 show excellent protein content relative to other rice varieties. Pawe-1 is significantly different from other rice varieties except NERICA-12 which has similar protein content in this study. But ANDASSA, GETACHEW, Edget and TANA rice varieties are poor in the protein contents in this study.

SUPARICA-1 and Pawe-1 is highly significantly different from other rice varieties and between each other in the crude fiber contents. On the other hand, NERICA-12 and TANA; Edget and Hidasse; Kallafo-1, ANDASSA, Kokit and GETACHEW are not significantly different in the crude fiber contents. In the carbohydrate content TANA is highly significantly different from Hidasse, Kallafo-1, Kokit, NERICA-12 and Pawe-1. Statistically, it has also similar carbohydrate content with GETACHEW, SUPARICA-1, ANDASSA and Edget. The total energy content of rice varieties is not significantly different in this study.

CONCLUSIONS

Statistically, these rice varieties have different qualities in the percentage of proximate composition. Almost all rice varieties have similar percent of moisture contents except GETACHEW, Kokit and Pawe-1varieties. Edget has highest ash content; Kokit and Pawe-1 have highest percent of fat, Pawe-1 and NERICA-12 have the highest and good protein content, SUPARICA-1 is the highest in crude fiber content and Pawe-1 is poor one. TANA, GETACHEW, SUPARICA-1, ANDASSA and Edget rice varieties have the highest and good carbohydrate source for nutrition. All rice varieties have similar total energy content. End users can be selecting these rice varieties according to the indicated percent of proximate analysis result and their preference for food formulation, nutrition and other purpose.

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