Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 6 (2016) 253 – 256

Procedia Food Science

International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015)

Proximate composition, calorie content and heavy metals (As, Cd, Pb) of selected Sri Lankan traditional rice (Oryza sativa L.) varieties

T. I. Kariyawasam[a], P. I. Godakumbura[a,*], M. A. B. Prashantha[a], G. A. S. Premakumara[b]

[a]*Department of Chemistry, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka*

[b]*Industrial Technology Institute, Colombo 7, 00700 , Sri Lanka*

Abstract

There are over 2000 Sri Lankan traditional rice varieties (STRV) known to have existed in Sri Lanka. But only about 30 varieties have been subjected to scientific research and proven to have high nutritional and medicinal properties. Therefore, uncovering the nutritional values of the rest of the STRV has become very important. Standard methods of AOAC nutritional guidelines were used to obtain the proximate composition of six STRV; Kalu heenati (KH), Pokkali (PK), Gurusinghe wee (GW), Kahawanu (KW), Sudu murunga (SM) and Unakola samba (US). Heavy metals (As, Cd and Pb) of these STRV were determined by using an ICP-AES.

The moisture content of selected STRV ranged from 11.2±0.2 % -11.9± 0.2 %. The results showed that crude protein content of the selected STRV was in the range of 9.7±0.3 % - 11.0±0.4 % KH had the highest crude protein content while SM had the least. In relation to crude fiber content, SM had the highest percentage (1.14±0.04 %), while the lowest (0.92±0.03 %) was recorded for KH. Crude fat content of all the STRV ranged from 2.3±0.0 % - 2.9±0.1 %. US had the highest crude fat content while PK and GW similarly had the least. PK had the highest ash content of 1.9±0.1 % and the least ash content of 1.2±0.0 % was shown by SM. Carbohydrate content of the selected STRV ranged from 72.0±0.1 % - 76.3±0.1 %. Calorie contents of the selected STRV were in the range of 352.3-372.8 Kcal/100 g and the highest value was reported for KH. The study reveals that the levels of As, Cd and Pb were below the limit of quantification (LOQ: Pb-0.04 ppm, As-0.02 ppm and Cd-0.01 ppm). Therefore, consumption of STRV may not cause metal toxicity due to Pb, Cd or As. This reveals that STRV show high nutritional values than those values reported for the improved rice.

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.036

Keywords: Sri Lankan traditional rice varieties; Proximate composition; Heavy metals

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).

1. Introduction

Rice is the main staple food as well as the highest priority crop in Sri Lanka and other parts of the Asia. In ancient times, over 2000 different varieties of rice are said to be grown all over Sri Lanka[1]. Sri Lankan traditional rice varieties (STRV) show high nutritional value, different texture, appearance, aroma and taste compared to improved rice varieties. Studies done for twenty five traditional rice varieties showed bioactivities such as antioxidant, anti-amylase, anti-glycation and anti-inflammatory properties and higher nutritional composition compared to improved varieties[2].

Each STRV has basic nutritional importance that can be assessed by their content of protein, carbohydrates, fats, ash etc. Thus, understanding of the overall composition and nutritional values of these STRV is essential. There is a developing trend in organic farming of SRTV for preserving the nutritional values and sustainability of the environment. Organic farming relies on techniques such as crop rotation, green manure, compost, and biological pest control. Therefore, considering the cost of fertilizer and pesticides as well as their harmful effects to humans and nature, cultivation of traditional rice varieties is definitely worth of having a better look. There are some claims that rice consumed in Sri Lanka is contaminated with some toxic heavy metals including arsenic and cadmium in recent years[3]. Several cases of human disease including Chronic Kidney Disease of unknown etiology (CKDu), disorders, malfunction and malformation of organs due to metal toxicity have been reported[3]. Therefore, studying the nutritional values and heavy metal contents of the rest of the STRV has become very important since there are over 2000 different STRV of which their nutritional values are still not known. This paper focuses the determination of nutritional values and heavy metals of Kalu heenati (KH), Pokkali (PK), Gurusinghe wee (GW), Kahawanu (KW), Sudu murunga (SM) and Unakola samba (US) as they are popularizing traditional rice among consumers.

2. Methodology

2.1 Preparation of paddy

Five traditional varieties of long grain rough rice consisting of KH (red), PK (red), GW (red), SM (white) and US (white) and one short grain rough rice variety consisting of KW (white), grown under organic farming (Fertilizers- cow dung, animal bones, hay, plant juices, compost; Biological pest control methods; Soil parameters- pH -5.4, salinity-0.03 dS/cm, soil colour-pale brown, soil moisture-49% , temperature-29 $^{\circ}$C) were used for the study. Rough rice samples were packed in polyethylene bags and stored in a refrigerator at 10 $^{\circ}$C.

2.2 Preparation of rice

Raw paddy was dehulled (Satake THU 35B), ground and passed through a 60-mesh sieve to obtain a homogeneous fine powder.

2.3 Proximate analysis

Uniform fractions of rice flour were used to analyze moisture, protein (%N x 6.25), fat, ash, fiber and carbohydrate by the methods of AOAC (2002).

2.4 Analysis of Metals

An amount of 5.0 g from each of the ground rice samples was taken to a crucible and ashing procedure was carried out at 550°C in a burning muffle for 6 h (n = 3). Then, about 50 drops of conc. Hydrochloric acid were added to the ash obtained and mixed well. It was filtered into a 250 ml volumetric flask and was topped up to the mark using distilled water. The final solutions were used to analyze selected heavy metals (As, Cd and Pb) present in samples using inductively coupled plasma atomic emission spectrometry (ICP-AES, Varian 720-EZ).

2.5 Calorie content

Calorie content (Kcal/ 100 g) was calculated by use of specific energy factors of 4:9:4 for proteins, fat and carbohydrates, respectively.

3. Results, Discussion, Conclusion and Recommendations

According to the results (Table 1) moisture content of selected STRV ranged from 11.2±0.2 % - 11.9± 0.2 %. The results showed that crude protein content of the selected STRV were in the range of 9.7±0.3 % - 11.0±0.4 %. This indicates that selected STRV contain higher amount of proteins compared to the improved varieties. Reported protein contents of improved rice varieties, Bg 352, Bg 300, Bg 403, Bg 94-1, Ld 356, At 306 and At 405 were in the range of 6%-11% [4]. KH had the highest crude protein content while SM had the least. In relation to crude fiber content, SM had the highest percentage (1.1±0.0 %). The lowest crude fiber content (0.9±0.0 %), was shown by KH. Crude fat content of the selected STRV ranged from 2.3±0.0 % - 2.9±0.1 % whereas the reported fat content of the improved varieties were in the range of 0.5%-1.4% [4]. US had the highest crude fat content while PK and GW similarly had the least. PK had the highest ash content of 1.9±0.1 % and the least ash content of 1.24±0.03 % was recorded for SM. Carbohydrate content of the selected STRV ranged from 72.0±0.1 % - 76.3±0.1 %. Accordingly, this study proves that selected rice varieties show higher percentages of proteins, fat, fiber and ash and lower percentage of carbohydrates compared to widely consumed Bg rice varieties (crude fat-1.26, protein-7.30, crude fiber-1.70, ash-1.2, carbohydrates-77) in Sri Lanka[5].

Calorific value of PK, KH, KW, SM, US and GW were 352.3, 372.6, 356.0, 357.5, 357.7 and 356.3 Kcal/100 g, respectively. Energy value of a food measures its value to the body as a fuel for metabolic processes, and it measures the chemical energy inherent in the bonds of the organic compounds of foods such as the protein, carbohydrate and fat constituents as well as minor constituents such as organic acids. All the varieties showed high energy values, and the highest was found in KH. Therefore, consumption of these nutrient rich rice varieties plays a vital role in decreasing nutritional deficiencies.

Selected heavy metals (As, Cd and Pb) in the selected STRV were below the limits of quantification (LOQ). LOQ: Pb-0.04 ppm, As-0.02 ppm and Cd-0.01 ppm. This proves that the consumption of STRV grown under above mentioned conditions may not cause heavy metal toxicity due to As, Cd or Pb.

Table 1. Proximate composition of Sri Lankan rice varieties.

Rice variety	Moisture %	Crude Protein %	Crude Fat %	Crude fibre %	Ash %	Carbohydrates %
Pokkali	11.9±0.2	10.9±0.2	2.3±0.0	0.9±0.0	1.9±0.1	72.0±0.1
Kalu heenati	11.2±0.2	11.0±0.4	2.6±0.3	0.9±0.0	1.8±0.0	76.3±0.1
Kahawanu	11.8±0.2	10.1±0.4	2.8±0.0	1.0±0.1	1.7±0.1	72.6±0.2
Sudu murunga	11.6±0.1	9.7±0.3	2.7±0.0	1.1±0.0	1.2±0.0	73.6±0.1
Unakola Samba	11.9±0.2	9.4±0.2	2.9±0.1	0.9±0.0	1.3±0.0	73.5±0.2
Gurusinghe wee	11.3±0.2	10.5±0.4	2.3±0.0	1.0±0.1	1.5±0.0	73.4±0.0

In conclusion, SRTV provides a nutritionally complete healthy food which is free from As, Cd and Pb compared to improved rice varieties in Sri Lanka as well as in other Asian countries.

Acknowledgements

The authors gratefully acknowledge P. Gurusinghe for sharing his immense knowledge on traditional rice cultivation.

References

1. Amarasingha UGS, Dahanayake N, Ranawake AL. Agronomic characters of some traditional rice (Oryza sativa L.) cultivars in Sri Lanka. *J.Univ.Ruhuna* 2013; 1 (1), 3-9
2. Abeysekera WKSM, Premakumara GAS, Ratnasooriya WD, Chandrasekharan NV, Bentota AP. Antioxidant, anti-amylase and anti-glycation potential of brans of some Sri Lankan traditional and improved rice (OryzasativaL.) varieties. *Journal of Cereal Science* 2013; 58 (3), 451-456
3. Jayasumana C, Paranagama P, Fonseka S, Amarasinghe M, Gunatilake S, Siribaddana S. Presence of arsenic in Sri Lankan rice. International Journal of Food Contamination 2015; 2:1
4. Fari MJM, Rajapaksa D, Ranaweera KKDS. Quality characteristics of noodles made from selected varieties of Sri Lankan rice with different physicochemical characteristics. J.Natn.Sci.Foundation Sri Lanka 2011; 39 (1), 53- 60
5. Perera MPMSH, Sivakanesan R, Abeysekara DTDJ, Sarananda KH. Sensory evaluation, proximate analysis and available carbohydrate content of soy flour incorporated cereal based traditional Sri Lankan breakfast foods. *International Journal of Research In Agriculture and Food Sciences* 2014; 1 (4), 10-19