Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 6 (2016) 344 – 347

Procedia Food Science

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

Nutritional composition and health related functional properties of *Eleusine coracana* (Finger Millet)

L. H. M. P. R. Lansakara[a], R. Liyanage[b], K. A. Perera[a], I. Wijewardana, B. C. Jayawardena[a] , J. K. Vidanarachchi[a,*]

[a]*Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[b]*Institute of Fundamental Studies, Hanthana Road, Kandy 20000, Sri Lanka*

Abstract

Nutritional composition, antioxidant activity, alpha amylase inhibitory activity and fermentation ability of Rawana and Oshada FM varieties were measured against Basmati and BG-300 rice varieties. The results showed that both soluble and insoluble dietary fiber (DF) contents were higher ($P<0.05$) in Rawana and Oshada than Basmati and BG-300. Moreover, soluble and insoluble DF contents of Oshada were higher ($P<0.05$) than Rawana. Total flavonoid content (TFC) of Rawana was similar to Basmati and BG-300. However, Oshada had the highest TFC. Total phenolic contents (TPC) of both FM varieties were higher ($P<0.05$) than both rice varieties. Oshada had a higher ($P<0.05$) TPC than Rawana. Both FM varieties showed a higher ($P<0.05$) 2, 2-diphenyl-1-picrylhydrazyl (DPPH) scavengingactivity than BG-300 and Basmati. Similarly, 2, 2'-*azino-bis-3-ethylbenzothiazoline-6-sulphonic acid*(ABTS) scavenging activity was higher ($P<0.05$) in both FM varieties than Basmati and BG-300. Furthermore, ABTS scavenging activity was higher ($P<0.05$) in Oshada than Rawana. Alpha amylase inhibitory activity of Rawana and Oshada were higher ($P<0.05$) than Basmati and BG-300. However, the IC_{50} values of both FM varieties were greater ($P<0.05$) than acarbose which is a drug used to treat type II diabetes. The results of the microbial fermentation study revealed that Rawana and Oshada produced a higher amount of hydrogen and carbon dioxide than rice varieties during the incubation at 39ºC with unadapted caecal microflora. Therefore, these results indicate that both FM varieties, particularly Oshada variety has more beneficial nutritional and health related protective effects than Basmati and BG-300 rice varieties *in vitro*.

* Corresponding author. Tel.: +94773922170
*E-mail address:*janakvid@pdn.ac.lk

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.069

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

Keywords:Eleusinecoracana; *Oryza sativa*; Functional properties; Nutritional composition;*in vitro*

1. Introduction

Cereals are important sources of dietary fiber, minerals and phytochemicals. Rice is the staple food in most Asian countries while finger millet is widely consumed by poor communities. However, finger millet has been known as a therapeutic food since ancient times for diabetes.

Cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are the major non-communicable diseases (NCD) which cause 63% of global deaths annually. In Sri Lanka, deaths due to NCDs account for 75% in year 2014.

It is well known that nutrition plays a vital role in the physical and mental wellbeing of human. Phytochemicals such as polyphenolic compounds in foods possess antioxidant effects which lead to reduce the risk of cancer and cardiovascular diseases. Moreover, phytochemicals act as carbohydrate hydrolyzing enzyme inhibitors[1]. Dietary fibers are partially or completely fermented by the microorganisms in the colon. Fermentation of soluble DF produces short chain fatty acids. Propionate acts as an inhibitor of cholesterol synthesis. Butyrate is the most important short chain fatty acid which provides energy to the colonic epithelium[2].

Therefore, the scope of present study was to determine the nutritional composition, antioxidant activity, alpha amylase inhibitory activity and fermentation ability of FM compared to rice in order to encourage its future applications in food industry as a functional food.

2. Materials and Methods

Dried seeds of pure Oshada and Rawana varieties of FMwere obtained from field crop research and development institute, Mahailuppallama. Basmati and BG-300 varieties of rice were acquired from local market and rice research institute, Bathalagoda respectively. Dried whole grains of Rawana, Oshada, Basmati and BG-300 were cleaned, groundand sieved to obtain whole meal flour.

Proximate composition, insoluble and soluble dietary fiber contentswere determined[3].

Total phenolic content and total flavonoid content were determined. 2,2-Diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay and*2,2 Azinobis 3 ethyl benzothiazoline 6 sulfonic acid* (ABTS) cation radical scavenging assay were conducted.

Alpha amylase inhibitory assays were conducted for all the four samples[3]. Microbial fermentation activity was determined by incubating the samples with unadaptiv ecaecal microflora.The bacteria for the fermentation were harvested from caecal contents of swine.0.5 g from each sample was taken into 15 mL vacutainer tubes and 8 mL of bacteria suspension was inoculated and allowed to incubate at 39 ºC. Hydrogen and carbon dioxide production at 0, 2, 4, 8, 18, 20 and 24 hours were analyzed using GC-9 AM Shimadzu Gas Chromatograph with a capillary column at 130ºC temperature.

The experimental design of the study was a complete randomized design (CRD). Treatment means were separated using General Linear Model procedure and means were separated by Least Significant Difference method at α=0.05. Data were Analyzed using SAS software package (SAS Institution Inc., 2003, Cary, USA).

3. Results, Discussion, Conclusion and Recommendations

Table 1.Nutritional composition, DF, Antioxidant constituents, Antioxidant activity, Alpha amylase inhibition and Gas production of Oshada, Rawana, BG-300 and Basmati.

		Oshada	Rawana	BG-300	Basmati
Nutritional composition	Dry matter (%)	97.68±0.54^{a}	98.18±0.63^{a}	95.75±0.34^{b}	95.97±0.24^{b}
	Ash (%)	2.01±0.22^{a}	1.61±0.14^{b}	2.31±0.44^{a}	0.40±0.14^{c}

	Crude protein (%)	6.48±0.21[a]		4.63±0.95[b]		9.98±1.08[c]		9.19±0.35[c]	
	Crude fat (%)	1.30±0.10[a]		3.14±0.41[b]		2.38±0.34[c]		2.51±0.24[c]	
	Crude fiber (%)	3.40±0.31[a]		3.17±0.53[a]		0.79±0.14[b]		0.09±0.03[c]	
	*NFE (%)	85.64±0.91[a]		85.64±0.91[a]		80.33±0.75[b]		83.79±0.33[c]	
DF	Soluble DF (%)	0.44±0.04[a]		0.38±0.02[b]		0.13±0.04[c]		0.04±0.03[d]	
	Insoluble DF(%)	11.62±0.35[a]		10.67±0.19[b]		7.44±0.02[c]		6.23±0.09[d]	
Antioxidant constituents	TPC (Gallic acid equivalents mg/ g of sample)	8.08±0.17[a]		6.40±0.09[b]		4.43±0.17[c]		3.85±0.18[d]	
	TFC (quercitin equivalent µg/mg of sample)	1.05±0.08[a]		0.39±0.01[b]		0.35±0.01[b]		0.37±0.01[b]	
Antioxidant activity	DPPH Assay [IC_{50} (mg/mL)]	2.44±0.22[a]		3.25±0.22[a]		7.45±1.42[b]		15.74±1.61[c]	
	ABTS Assay (Trolox Equivalent mg/100mg)	70.97±2.63[a]		45.58±0.99[b]		5.24±0.06[c]		1.37±0.08[d]	
Alpha amylase inhibition[IC_{50} (mg/mL)]		30.78±3.52[a]		37.88±2.89[a]		69.86±6.34[b]		74.83±6.34[b]	
Gas production	Incubation time (h)	H_2 (%)	CO_2 (%)	H_2 (%)	CO_2 (%)	H_2 (%)	CO_2 (%)	H_2 (%)	CO_2 (%)
	0	0.002	3.58	0	1.15	0	1.93	0	1.03
	2	0.03	5.43	0.002	1.82	0.003	2.15	0.004	1.76
	4	0.13	6.27	0.004	4.89	0.01	4.30	0.1	4.43
	8	3.32	11.05	0.01	8.40	0.02	7.03	0.83	5.86
	18	8.36	19.46	2.87	12.12	2.77	12.97	2.99	9.89
	20	12.30	24.17	7.68	15.89	4.68	17.94	4.22	11.65
	24	14.54	27.16	10.99	24.19	9.65	20.15	5.97	20.85

Values (g/100g) are expressed as Mean Standard Deviation (n=4) on dry matter basis.
Values with different superscripts within a column are significantly different at P<0.05.
*Nitrogen Free Extract- Calculated by subtracting protein, fat, ash and fiber from dry matter.

The results showed that (Table 1) protein content was higher (P<0.05) in both rice varieties than Rawana and Oshada. Rawana had the highest (P<0.05) fat content while Oshada had the lowest fat content.

The soluble and insoluble DF contents of Oshada and Rawana were higher (P<0.05) than BG-300 and Basmati.Moreover, soluble and insoluble dietary fiber contents of Oshada were higher (P<0.05) than Rawana. The results of the present study showed that soluble and insoluble dietary fiber contents of BG-300 were higher (P<0.05) than Basmati.

TPC of Oshada and Rawana were significantly higher (P<0.05) than that of Basmati and BG-300. The results of the present study are in accordance with the results of a similar study in which TPC of FM has compared with rice[4].

The total flavonoid contents of BG-300, Basmati and Rawana were not significantly different (P>0.05). However, Oshada had higher (P<0.05) flavonoid content than Rawana, Basmati and BG-300.

The results of the DPPH assay revealed that antioxidant activity was higher (P<0.05) in Oshada andRawana than BG-300 and Basmati. It was not significantly different (P>0.05) between Oshada and Rawana varieties. Out of the two rice varieties, BG-300 showed a higher (P<0.05) antioxidant activity than Basmati. Even though the TFC of Rawana was similar to that of BG-300 and rice, the DPPH scavenging activity was higher (P<0.05) in Rawana than BG-300 and rice. The higher DPPH scavenging activity of Rawana may be due to its high content of phenolics.

Trolox equivalent antioxidant activity values were higher (P<0.05) in Rawana and Oshada than that of BG-300 and Basmati. Moreover, it was higher (P<0.05) in Oshada than Rawana. Out of two rice varieties, BG-300 had a higher (P<0.05) ABTS cation radical scavenging activity than Basmati. These results are related with the results of total phenolic content, indicating that phenolic compounds highly contribute to the ABTS cation radical scavenging

activity. Oshada variety which had a higher amount of flavonoids, exhibit the highest ABTS cation radical scavenging activity.

Results of the alpha amylase inhibitory assay showed that IC_{50} values of Oshada and Rawana were lower ($P<0.05$) than that of BG-300 and Basmati. However, any significant difference was not observed between the IC_{50} values of Rawana and Oshada as well as Basmati and BG-300. Acarbose is a drug which used to treat type II diabetes. Acarbose had a very lower IC_{50} value. Therefore, IC_{50} values of both FM varieties were much greater ($P<0.05$) than that of acarbose. Recent studies have identified the wound healing properties of finger millet on diabetic rats[5]. Therefore, even though finger millet exhibits hypoglycemic activity, it may not be associated with inhibition of alpha-amylase enzyme.

Production of hydrogen during the incubation time follows the expected trend in relation to the DF content. Oshada which had the highest DF content showed the highest hydrogen production. Similarly, Basmati which reported the lowest DFcontentexhibited the lowest hydrogen production. Production of carbon dioxide not necessarily follows the expected trend with respect to DF content. However, in the current study,Oshada which had the highest DF contentgenerated the highest carbon dioxide production.

Overall results of the study support the conclusion that, health related functional properties of Rawana and Oshada are higher than that of Basmati and BG-300. Out of the two FM varieties, Oshada is having better functional properties than Rawana. Furthermore, investigation of hypocholesterolemic activity of FM would be valuable.

3. References

1. Nickavar B, Abolhasani L, Izadpanah H. **α**-Amylase inhibitory activities of six *Salvia* species**.** *Iran. j. pharm. res.* 2008; 7(4): 297-303.
2. Drizikova B, Dongowski G, Gebhardt E, Habel A. The composition of dietary fibre-rich extrudates from oat affects bile acid binding and fermentation in vitro. *Food Chem* 2005; 90:181-192.
3. *Official Methods of Analysis of AOAC International*, 16th ed. Suite 500: 481: North Frederick Avenue: Gaithersburg: Maryland: 20877-2417: USA; 1995.
4. Saldivar S. Cereals: dietary importance. In: Caballero B, Trugo L, Finglas P, editors. *Encyclopedia of Food Sciences and Nutrition*. Academic Press: Agosto: London; 2003. p. 1027-1033.
5. Rajasekaran NS, Nithya M, Rose C, Chandra TS. The effect of finger millet feeding on the early responses during the process of wound healing in diabetic rats. *BiochimBiophysActa* 2004; 1689:190- 201.