I.J.S.N., VOL.7 (3) 2016: 680-684 ISSN 2229 – 6441

INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

NUTRITIONAL PROFILING OF RICE BRAN AND VEGETABLE POMACE POWDERS INCORPORATED EXTRUDATES

[1]Bhagya Lakshmi, N., [1*]Jessie Suneetha, W., [1]Uma Maheswari, K., [2]Neeraja Prabhakar, B. & [1]Anila Kumari, B.
[1]Post Graduate & Research Centre, Department of Foods & Nutrition, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad – 500 030.
[2]Department of Horticulture, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad – 500 030
*Corresponding author email: wjsuneetha@yahoo.com

ABSTRACT
The extrudates with rice flour to refined wheat flour in the ratio of 40:60 was selected to which stabilized rice bran added at 15% was found to be the best. To this standardized extrudate, BPP of 7.5% or CTP of 5% added were found to be most accepted products. The moisture content varied from 6.72 to 7.22 in each of the extrudates. The value added extrudates showed decrease in moisture content from 3 to 7% in comparison with control extrudate. The ash content varied from 2.34 to 3.26. The results obtained showed that the fat content in extrudates ranged from 0.77 to 1.23. The protein content varied from 22.99 to 24.95 with no significant difference between the extrudates ($p<0.05$). The carbohydrate content varied from 62.87 to 66.13 in the extrudate. The carbohydrate content decreased between 2.0– 4.93% in the extrudates in comparison to control. The minerals in extrudates analysed were sodium, potassium, iron and zinc. The values for sodium ranged from 1.13-7.32, potassium content from 37.43 to 71.30; iron from 5.46 to 7.73 and zinc from 2.77 to 5.74 mg/100g.

KEY WORDS: Rice bran extrudates, proximate analysis, sodium, potassium, iron and zinc.

INTRODUCTION
Rice contains approximately 7.3% protein, 2.2% fat, 64.3% available carbohydrates, 0.8% fiber and 1.4% ash content (Zhou *et al.,* 2002). Rice is a good source for making gluten-free foods, as it has hypoallergenic properties due to the absence of gliadin (Gujral and Rosell, 2004). Rice flour has become an attractive ingredient in the extrusion industry due to its bland taste, attractive white colour, hypoallergenicity, ease of digestion along with low levels of sodium, fat and protein levels (Kadan *et al*., 2003). Rice bran, the brown outer layer of rice kernel is mainly composed of pericarp, aleuron/sub-aleurone layers and germ. Currently it is discarded as a waste product during rice milling in India. However, it is an excellent source of total dietary fiber ranging from 20 - 51% (Saunders, 1990). Rice bran and rice bran oil have potential health benefits such as cancer, kidney stones, heart disease and hyperlipidaemia due to the high content of γ-oryzanol (Godber *et al*., 2004). Rao and Thejaswini (2015) studied extrusion technology as a novel method of food processing which is gaining popularity in the global agro-food processing industry. Extrusion cooking technologies are used for cereal and protein processing at relatively low temperatures for preparations of pasta, spaghetti, noodles, *etc.*

MATERIALS & METHODS
Stabilization of rice bran
Rice bran stabilization was carried as per the procedure given by Malekian *et al.,* 2000.

Preparation of rice flour
The polished MTU 1001 rice variety was soaked in water, drained, sun dried, milled to fine powder and sieved to a particle size of 2.00 mm and packed in an air tight container till further usage.

Value addition with CTP or BPP to rice bran extrudates
The rice bran extrudates were incorporated with cauliflower trimmings powder (CTP) at 4 different levels i.e. 5, 10, 15 and 20 % levels and beet root pomace powder (BPP) at 4 different levels i.e. 7.5, 10, 12.5 and 15 % by the process of folding and passing through rollers of pasta presto making machine several times. Sheeted dough was extruded through a suitable die (width, 2.0 mm), cut to have desired size of extrudates and shade dried for 16 hrs. Now these standardized cold extrudates were steamed for 20 min at 102 – 105°C, spread over tray drier and dried for 1 hr at 60 °C. The dried products were boiled for 6 min and the sensory evaluation was conducted using 9 point hedonic scale by 15 semi trained panelists.

Selection of best extrudates
The extrudates with rice flour to refined wheat flour in the ratio of 40:60 was selected to which stabilized rice bran added at 15% was found to be the best. To this standardized extrudate, BPP of 7.5% or CTP of 5% added were found to be most accepted products. Proximate analysis was carried to these extrudates as per the procedures followed by

standard AOAC methods. Moisture, ash and protein (AOAC, 2005), fat (AOAC, 1997), carbohydrate and energy (AOAC, 1989), crude fiber (AOAC, 1990) and total dietary fiber (AOAC 2000) were used. Minerals like sodium and potassium in flame photometer (AOAC, 1990) along with zinc and iron in AAS (AOAC, 1990) were estimated for the extrudates.

RESULTS & DISSCUSION

Proximate analysis of extrudate

The extrudates were analysed for the proximate composition which include moisture, ash, protein, fat, carbohydrate and energy content presented in Table 1. The percentage change in the proximate composition was shown in the Figure 1.

Moisture

The moisture content varied from 6.72 to 7.22 in each of the extrudates. The moisture content of control extrudate was highest and the least was observed for BPP added extrudate. The value added extrudates showed decrease in moisture content from 3 to 7% in comparison with control extrudate. The increasing order was BPP extrudate > CTP extrudate > CRB extrudate > control. There was a significant difference ($p<0.05$) in the moisture content of the extrudates. Kumar *et al*. (2011) observed that moisture content varied from 4.03 to 4.79% with an average moisture content of 4.41% for cookies with pomace incorporation. The moisture content of cookies increased with the increase in pomace level resulting in decreased storage stability. The addition of BPP or CTP to extrudates decreased the moisture content due to increase in porosity and availability of bound moisture. The decrease in moisture content was 2.9, 6.9 and 5.4% respectively for CRB, BPP and CTP extrudates in comparison to control.

Ash

The results indicated that ash content showed no significant difference ($p<0.05$) amongst the extrudates. The ash content varied from 2.34 to 3.26. The increasing order was CTP extrudate > BPP extrudate > CRB extrudate > control. Reddy *et al.* (2014) showed that on addition of roots and tubers the ash content in experimental samples ranged from 0.54 ±0.26 to 3.32 ±0.28 g. The extrudates with yam, taro and sweet potato showed similar ash content of 3.32 ±0.28, 3.26 ±0.16 and 3.28 ±0.14 respectively, whereas the potato (0.54 ±0.26) and beetroot (1.34 ±0.30) incorporated extrudates had slightly lower ash content. The vegetables are good sources of minerals and addition of BPP and CTP powders increased the ash content by 28.0 and 28.2% increase in BPP and CTP extrudates where as in CRB extrudate it was 16.4%.

Fat

The results obtained showed that the fat content in extrudates ranged from 0.77 to 1.23. The highest was for stabilized rice bran added extrudate and lowest for BPP extrudate. The fat content in CRB extrudate may be high as whole fat stabilized rice bran was added and rice bran is a good source of vegetable oil. The increasing order was CRB extrudate > control extrudate > CTP extrudate > BPP extrudate. The vegetable waste added extrudates had lower fat content in comparison to control and CRB extrudates. The CRB extrudate showed an increase of 23.0% where as BPP and CTP, the fat content decreased by 23.0 and 14.0% respectively.

Protein

The protein content varied from 22.99 to 24.95 with no significant difference between the extrudates ($p<0.05$). High protein content was seen in CTP extrudate and lower content in control extrudate. The increasing order was CTP extrudate > BPP extrudate > CRB extrudate > control. The BPP and CTP added extrudates had higher protein percentage because vegetables are composed of nitrogenous matter as shown with an increase of 6.3 and 7.8% for BPP and CTP extrudates. There was a significant ($p<0.05$) increase of 13% for CRB extrudate in comparison with control extrudate.

Carbohydrates

The carbohydrate content varied from 62.87 to 66.13 in the extrudate. The highest content was for control extrudate with CRB, BPP and CTP extrudates showing a decrease of 2.0, 3.76 and 4.93% in the carbohydrate content. The purpose of adding stabilized rice bran or vegetable waste powders was to increase the available starch content to a certain extent with WAI and thus to improve the total dietary fiber content in the extrudates and replace refined wheat flour that contains high amounts of gluten.

Energy

The energy content varied from 359.16 to 365.50 kcal/100g. The highest content was seen in control extrudate and lowest content in BPP and CTP added extrudates. The energy content decreased between 0.6 to 1.73% in the value added products. The addition of vegetable waste powders decreased the total carbohydrate and energy content but improved the ash and protein content. The addition of beetroot leaves powder and chickpea flour to rice flour resulted in increase in protein and crude fiber content in extruded product. This extruded product contained moisture of 4.74%, ash of 1.98%, fat of 1.05%, crude fiber of 3.65% and carbohydrate of 78.68% (Kakade *et al.*, 2015). Development of extruded ready-to-eat (RTE) snacks using corn, black gram, roots and tuber flour blends in a proportion of 60:80:20:20 respectively had fat content ranging from 5.14 ±0.26 to 10.89 ±0.19 g/100g with the highest value in taro incorporated extrudate and the least in beetroot incorporated extrudate. The improved fat content in the RTE extrudates was due to the addition of oil and spices (Reddy *et al.*, 2014).

The protein and fiber content and functional characteristics of incorporation of wheat, rice, barley and oat brans were evaluated. The crude protein ranged from 9.6-15.03%, fat 4.07-19.31%, dietary fibre 14.0-38.95%, bulk density 0.39-0.59 g/ml, water absorption 115.20-383.70%, fat absorption 138.3-302.9% and free fatty acids 5.20-13.73%. All brans had pleasing flavour and colour of products varied significantly based on brans added to them (Kaur *et al.*, 2011).

TABLE 1. Proximate composition of standardized extrudates

Extrudate	Moisture (g/100g)	Ash (g/100g)	Fat (g/100g)	Protein (g/100g)	Carbohydrates (g/100g)	Energy (Kcal)
Control	7.22^{a} ±0.01	2.34^{c} ±0.06	1.00^{b} ±0.09	22.99^{d} ±0.31	66.13^{a} ±0.37	365.50^{a} ±0.64
CRB	7.01^{b} ±0.00	2.80^{b} ±0.04	1.23^{a} ±0.19	23.31^{c} ±0.21	64.75^{b} ±0.39	363.28^{b} ± 0.94
BPP	6.72^{d} ±0.00	3.25^{a} ±0.08	0.77^{b} ±0.01	24.54^{b} ± 0.18	62.87^{d} ±0.06	359.16^{d} ± 0.47
CTP	6.83^{c} ±0.00	3.26^{a} ±0.09	0.86^{b} ±0.03	24.95^{a} ±0.14	63.65^{c} ±0.19	359.69^{c} ± 0.11
Mean	6.94	2.19	0.96	23.95	64.35	361.91
CD value	0.0131	0.049	0.195	0.308	0.423	0.811
SE	0.0053	0.0202	0.0796	0.1260	0.1730	0.3313
CV (%)	0.09	0.08	10.13	0.64	0.33	0.11

Note: Values are expressed as mean ± standard deviation of three determinations.
Means within the same column followed by a common letter do not significance differ at $p \leq 0.05$
Control: Rice flour + refined wheat flour extrudate
CRB: Control + stabilized rice bran extrudate
BPP: Beetroot pomace powder incorporated CRB extrudate
CTP: Cauliflower trimmings powder incorporated CRB extrudate

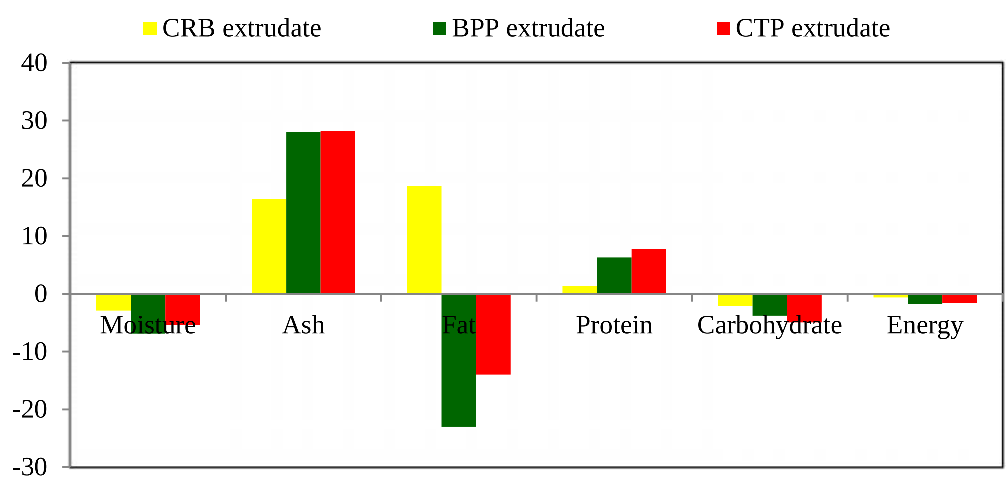

FIGURE 1. Percentage change in proximate analysis of extrudates

Mineral content in extrudates

The incorporation of stabilized rice bran and vegetable pomace powders increased the mineral content in the products in comparison with control as shown in Table 2. The sodium content in extrudates showed significant difference ($p<0.05$) between control and value added products. The values for sodium ranged from 1.13-7.32, potassium content from 37.43 to 71.30; iron from 5.46 to 7.73 and zinc from 2.77 to 5.74 mg/100g. The increasing order for sodium and potassium was control extrudate < CRB extrudate < CTP extrudate < BPP extrudate, iron and zinc was control extrudate < CRB extrudate < BPP extrudate < CTP extrudate.

TABLE 2. Mineral content in standardized extrudates

Extrudate	Sodium	Potassium	Iron	Zinc
Control	1.13^{d}±0.09	37.43^{d}±0.06	5.46^{d}±0.008	2.77^{d}±0.004
CRB	3.26^{c}±0.08	42.56^{c}±0.05	6.22^{b}±0.009	4.24^{c}±0.004
BPP	7.32^{a}±0.10	71.30^{a}±0.26	6.81^{c}±0.006	4.31^{b}±0.03
CTP	5.41^{b}±0.06	56.80^{b}±0.10	7.73^{a}±0.006	5.74^{a}±0.05
Mean	4.28	52.02	6.55	4.27
CD value	0.2050	0.2744	0.0007	0.0656
S.E	0.0837	0.1121	0.003	0.0245
C.V (%)	2.39	0.26	0.06	0.70

Note: Values are expressed as mean ± standard deviation of three determinations.
Units expressed as mg /100g.
Means within the same column followed by a common letter do not significance differ at $p \leq 0.05$.
Control: Rice flour + refined wheat flour extrudate

CRB: Control + stabilized rice bran extrudate
CTP: Cauliflower trimmings powder extrudate
BPP: Beetroot pomace powder extrudate

Sodium and potassium was highest for BPP extrudate where iron and zinc was highest for CTP extrudate. Wani and Sood (2014) and Sikandra and Boora (2009) reported that biscuits incorporated with cauliflower leaf powder had iron content ranging from 5.59 to 5.10 mg/100g in comparison to plain biscuits. The mineral content showed significant difference ($p<0.05$) between the control and experimental extrudate. The increase in the mineral content of the experimental extrudates was shown in Figure 2. The sodium content increased by 65.3, 84.5 and 79.1%, where as potassium increased by 12.0, 47.5 and 34.1 for CRB, BPP and CTP extrudates. The iron content increased by 12.2, 19.8 and 29.3%, where as zinc content increased by 34.6, 35.7 and 51.7% for CRB, BPP and CTP extrudates.

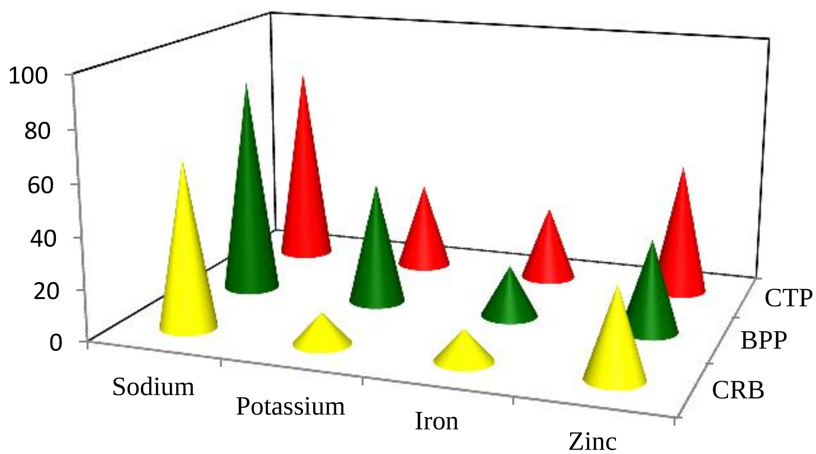

FIGURE 2. Percentage change in mineral content of standardized extrudates

The increase in sodium and potassium content was high in BPP extrudate followed by CTP extrudate where as CTP was a good source of iron and zinc. The CTP can be used as a source of iron which is lacking in many foods at a very low processing cost as cauliflower trimmings are discarded. The rice bran supplementation at 5, 10 and 15% levels to wheat bread showed significant ($p<0.05$) increase in the mineral content. The iron content increased from 9.32 to 20.52 and potassium content from 80.74 to 188.20 mg/100g sample (Ameh *et al.,* 2013). The replacing of wheat flour with infrared stabilized rice bran (SRB) at the levels of 2.5, 5 and 10.0% significantly ($p<0.05$) increased the zinc, iron sodium and phosphorus content of the breads (Tuncel *et al.,* 2014b). The iron, copper, manganese and zinc contents of cauliflower leaves powder were 43.11, 60.38, 1.55, 5.86 and 5.10 mg/100g sample respectively (Wani *et al.,* 2011). The extrudate rice flour product incorporated with beetroot pomace and pulse powders showed an increase of 20-25% in phosphorus and iron content (Sinha and Masih, 2014).

CONCLUSION

Control extrudate had significantly higher ($p<0.05$) moisture, carbohydrate and energy content than the extrudate with CRB, BPP and CTP. The calorie content was higher but non-significant ($p<0.05$) due to high carbohydrate content. The vegetable waste added extrudates had lower fat content in comparison to control and CRB extrudates. High protein content was seen in CTP extrudate and lower content in control extrudate. The adding of rice bran and vegetable waste powders decreased the requirement of α –glucosidase enzyme. There was not much change in the carbohydrate content due to the addition of stabilized rice bran and vegetable waste powders in comparison with the control extrudate. The incorporation of stabilized rice bran and vegetable waste powders increased the mineral content in the products in comparison with control.

REFFERENCES

Ameh, M.O., Gernah, D.I., Bibiana, D and Igbabul (2013) Physico-chemical and sensory evaluation of wheat bread supplemented with stabilized undefatted rice bran. *Food and Nutrition Sciences*. 4: 43-48.

AOAC (1990) Official methods of analysis for fiber. *Association of Official Analytical Chemists. 14th edition.* Washington DC. USA.

AOAC (1990) Official methods of analysis for mineral analysis. *Association of Official Analytical Chemists. 14th edition.* Washington DC. USA.

AOAC (1997) Official methods of analysis for fat (crude) or ether extract in flour. *Association of Official Analytical Chemists.* 16th Ed. 3rd Revision. Gaithersburg, Maryland 20877-2417.

AOAC (2000) Methods of analysis, 17th Edition. *Association of Official Analytical Chemist* Washington DC, USA.

AOAC (2005) Official methods of analysis for ash in flour. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.

AOAC (2005) Official methods of analysis for moisture in flour. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.

AOAC (2005) Official methods of analysis for protein. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.

Godber, J., Xu, Z., Hegsted, D and Walker, T. (2004) Rice and rice bran oil in functional foods development. *Louisiana Agriculture*. 45(4): 9-10.

Gujral, H.S and Rosell, C.M. (2004) Functionality of rice flour modified with a microbial transglutaminase. *Journal of Cereal Science*. 39: 225-230.

Kadan R.S., Bryant, R.J and Pepperman, A.B. 2003. Functional properties of extruded rice flours. *Journal of Food Science*. 68: 1669-1672.

Kakade, S.B., Hathan, B.S and Neeha, V.S. (2015) Utilization of beetroot (*Beta vulgaris. L*) leaves powder in cereals based extruded product. *International Research Journal of Engineering and Technology*. 2(3): 2153-2161.

Kaur, S., Sharma, S and Nagi, H.P.S. (2011) Functional properties and anti-nutritional factors in cereal bran. *Asian Journal of Food and Agro-Industry.* 4(2): 122-131.

Kumar, N., Sarkar, B.C. and Sharma, H.K. (2010) Development and characterization of extruded product of carrot pomace, rice flour and pulse powder. African Journal of Food Science. 4(11): 703 – 717.

Malekian, F., Rao, R.M., Prinyawiwatkul, W., Marshall, W.E., Windhauser, M and Ahmedna, M. (2000) Lipase and lipoxygenase activity, functionality and nutrient losses in rice bran during storage. *Louisiana Agricultural Experiment Station LSU* Agricultural Center Baton Rouge, LA, 870: 70894-5055.

Rao, H.G.R and Thejaswini, M.L. (2015) Extrusion technology: A novel method of food processing. *International Journal of Innovative Science, Engineering and Technology*. 2(4): 358-369.

Reddy, M.K., Kuna, A., Devi, N.L., Krishnaiah, N., Kaur, C and Nagamalleswari, Y. (2014) Development of extruded ready-to-eat (RTE) snacks using corn, black gram, roots and tuber flour blends. *Journal of Food Science and Technology.* 51(9): 1929–1937.

Saunders, R.M. (1990) The properties of rice bran as a food stuff. *Cereal Foods World*. 35(6): 632-639.

Sikandra and Boora, P. (2009) Nutritional evaluation of sorghum and chickpea incorporated value added products. *Journal of Dairying, Foods and Home Science.* 28(3-4): 181-185.

Sinha, P. and Masih, D. (2014) Development and quality evaluation of extruded product of rice flour incorporated with beetroot (*Beta Vulgaris*) pomace and pulse powder. *International Journal of Scientific Research.* 3(8): 148-150.

Tuncel, N.B., Yilmaz, N., Kocabiyik, H. and Uygur, A. (2014b.) The effect of infrared stabilized rice bran substitution on B vitamins, minerals and phytic acid content of pan breads: Part II. *Journal of Cereal Science.* 52(2): 162–166.

Wani, T.A. and Sood, M. (2014) Effect of incorporation of cauliflower leaf powder on sensory and nutritional composition of malted wheat biscuits. *African Journal of Biotechnology.* 13(9): 1019-1026.

Wani, T.A., Sood, M. and Kaul, R.K. (2011) Nutritional and sensory properties of roasted wheat noodles supplemented with cauliflower leaf powder. *Annals Food Science and Technology*. 12(2): 102-107.

Zhou, Z., Robards, K., Helliwell, S and Blanchard, C. (2002) Composition and functional properties of rice. *International Journal of Food Science Technology,* 37: 849–868.