The Pharma Innovation Journal 2022; 11(11): 2561-2564

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 2561-2564

www.thepharmajournal.com
Received: 01-08-2022
Accepted: 05-09-2022

K Srilekha
Ph.D. Scholar (Food Science and Nutrition) University of Agricultural Sciences, Dharwad, Karnataka, India

Sarojani J Karakannavar
Professor (Food Science and Nutrition) University of Agricultural Sciences, Dharwad, Karnataka, India

Hemalatha S
Professor and Head (Food Processing and Technology) University of Agricultural Sciences, Dharwad, Karnataka, India

Ashwini M
Junior Microbiologist (AICRP on EAAI), University of Agricultural Sciences, Dharwad, Karnataka, India

Nagappa G
Agrostologist (Fodder research and production unit) University of Agricultural Sciences, Dharwad, Karnataka, India

Corresponding Author:
K Srilekha
Ph.D. Scholar (Food Science and Nutrition) University of Agricultural Sciences, Dharwad, Karnataka, India

Development and evaluation of value added products from resistant starch rich browntop millet based health mix

K Srilekha, Sarojani J Karakannavar, Hemalatha S, Ashwini M and Nagappa G

Abstract
Resistant starch is the sum of starch and products of starch hydrolysis that are not absorbed in small intestine. Resistant starch is known to manage diabetes and possess cardio protective properties. Resistant starch content of Indian foods ranges from 1.2 to 1.8 (g/100 g) in cereals, 2 to 3.4 (g/100 g) in legumes, 0.3 to 1.3 in vegetables, 0.7 to 3.3 (g/100 g). This indicates that Indian diets are low in resistant starch. Therefore, resistant starch rich foods need to be developed. In the present study value added products (chapati, soup, idli and dosa) were developed from resistant starch rich browntop millet based health mix. It was found that chapati, soup was acceptable up to100 percent with acceptability index of 85 and 97 percent respectively. Idli and dosa was acceptability up to 75 percent with acceptability index of 79 percent. Hence, it can be concluded that value added products good sensory acceptance developed with resistant starch rich browntop millet based health mix.

Keywords: Browntop millet, resistant starch, value-addition, traditional products

Introduction
Then term "resistant starch" was coined to describe portion of starch that cannot be completely broken down in a test tube (Sharma *et al*., 2008) [13]. Starch fraction that is resistant to enzyme hydrolysis after 180 minutes of ingestion is called as resistant starch. Resistant starch is the sum of starch and products of starch hydrolysis that are not absorbed in small intestine. (Park *et al.*, 2004) [10]. Resistant starch reduces risk of cardiovascular diseases by lowering dietary fat absorption, increasing faecal excretion, lowering blood cholesterol level. (Nichenametla *et al*., 2014) [9] (Peterson *et al*., 2018) [11] (Keenan and Ravussin 2018) [5] (Park *et al*. 2004) [10]. It was found that consumption of 6 grams of resistant starch lowered cholesterol by 7.2% and LDL by 5.5%. (Nichenametla *et al*., 2014) [9]. Consumption of resistant starch manages obesity by decreasing metabolizing energy values of foods, increasing thermic effect of food, by lowering energy intake (Higgins and Janine, 2014) [3]. Resistant starch content of Indian foods ranges from 1.2 to 1.8 (g/100 g) in cereals, 2 to 3.4 (g/100 g) in legumes, 0.3 to 1.3 in vegetables, 0.7 to 3.3 (g/100 g). This indicates that Indian diets are low in resistant starch. Though whole millets contain 20-30 gram of resistant starch dehulling reduces resistant starch to 1-4 g/100 g (Sharma and Gujral 2019; Birt *et al*., 2013; Kaimal *et al*., 2021) [12, 2, 4]. Thus, focus can be shifted to increase of resistant starch content of foods. Therefore, present study is aimed to develop traditional products from resistant starch rich browntop millet based health mix that is developed as part of research work.

Material and Methods
Resistant starch rich browntop millet based health mix developed as a part of Ph.D. research work was used for the development of value-added products. Other ingredients like wheat flour, idli ravva, corn flour and vegetables like carrot, beans and capsicum were procured from local markets of Dharwad.

For preparation of chapati, wheat flour was replaced with 25, 50, 75 and 100% of resistant starch rich browntop millet based health mix. For preparation of soup, corn flour was replaced with 25, 50, 75 and 100% of resistant starch rich browntop millet based health mix. For preparation of idli, black gram dhal was replaced with 25, 50, 75 and 100% of resistant starch rich browntop millet based health mix. For preparation of dosa, wheat flour was replaced with 25, 50, 75 and 100% of resistant starch rich browntop millet based health mix.

All the developed products were subjected sensory evaluation by 15 semi-trained panellists) (Amerine *et al*., 1965) [1]. Proximate composition of best accepted product was computed from Indian food composition table (Longvath *et al*., 2017).

Results and Discussion

Table 1 presents sensory scores and acceptability index of chapatis prepared with different proportions of resistant starch rich browntop millet based health mix. Replacement of wheat flour with resistant starch rich browntop millet based health mix had significantly ($p \leq 0.01$) influenced appearance, flavour, taste, after taste, texture and overall acceptability. The sensory scores for chapatis ranged from 8.00 to 8.13 for colour, 8.40 to 7.33 for appearance, 7.53 to 8.26 for flavour, 8.26 to 8.40 for taste, 8.00 to 7.06 for after taste, 8.20 to 7.00 for texture and 7.93 to 7.80 for overall acceptability for all the treatments. T_1 (100% wheat flour), T_2 (50% RS-BHM), T_3 (75% RS-BHM) were found on par to each with respect to colour, appearance, after taste, texture and overall acceptability. Taste increased significantly ($p \leq 0.01$) in T_2 (9.00) and T_3 (8.66) compared to T_1 (8.26). Flavour increased significantly in T_2 (8.20) and T_3 (8.20) compared to T_1 (7.53). Though the sensory scores of T_4 (100% RS-BHM) were significantly lower than T_1, T_2, T_3 with respect to appearance (7.33), taste (8.40), after taste (7.06) and texture (7.00) they were within acceptable range. Colour (8.13), overall acceptability (7.80) of T_4 was found to be on par to other treatments. Acceptability index of T_4 (Wheat flour: RS-BHM-0:100) was 85.71 percent. Therefore, T_4 i.e., chapati prepared with 100 percent RS-BHM with acceptable sensory scores and acceptability index was considered as best. The results of present were on par with results reported by Mounika *et al*. (2020) [7], where 100 percent millet flour chapatis had good acceptability of 8.00.

Table 2 presents sensory scores of soups and acceptability index prepared with different proportions of resistant starch rich browntop millet based health mix. Replacement of corn flour with resistant starch rich browntop millet based health mix (RS-BHM) had significantly ($p \leq 0.01$) influenced colour, appearance, taste, after taste, flavour, texture and overall acceptability. Sensory scores ranged from 7.13 to 9.00 for colour, 7.00 to 8.33 for appearance, 6.73 to 9.00 for flavour, 7.53 to 9.00 for taste, 7.66 to 8.06 for after taste, 7.06 to 9.00 for consistency and 7.26 to 8.80 for overall acceptability. It is indicative that T_4 (100% RS-BHM) had significantly higher scores for colour (9.00), appearance (8.33), flavour (9.00), taste (9.00), consistency (9.00) and overall acceptability (8.80) and T_4 also had highest acceptability index of 97.14 percent. Therefore, soups prepared with 100 percent resistant starch rich browntop millet based health mix was the best accepted treatment among all.

Table 3 presents sensory scores and acceptability index of idlis prepared with different proportions of resistant starch rich browntop millet based health mix. Replacement of idli rava with resistant starch rich browntop millet based health mix had significantly ($p \leq 0.01$) influenced colour, appearance, taste, after taste, flavour, texture and overall acceptability. Sensory scores ranged from 7.33 to 8.86 for colour, 7.60 to 8.80 for appearance, 7.00 to 8.60 for flavour, 7.00 to 8.60 for taste, 7.33 to 8.20 for after taste, 6.73 to 7.93 for consistency and 7.06 to 8.20 for overall acceptability. Sensory scores for colour, appearance, flavour and overall acceptability increased significantly ($p \leq 0.01$) in T_2 (25% RS-BHM) and T_3 (50% RS-BHM) compared to T_1 (0% RS-BHM). T_2 and T_3 were on par to each other with respect to color, appearance, after taste, however flavour (8.60) and taste (8.60) scores of T_3 (50% RS-BHM) were significantly ($p \leq 0.01$) higher scores than T_2 flavour (8.00) and taste (8.00) scores. Flavour, taste, after taste, texture and overall acceptability scores of T_4 (75% RS-BHM) were significantly ($p \leq 0.01$) lower than other treatments and colour and appearance scores of T_4 were on par to T_1 and significantly lower than T_2 and T_3. Though scores of T_4 were lower compared to other treatments they were within acceptable range. Therefore, T_4 (idli prepared with 25% idli rava, 75% RS-BHM and 0% black gram) with acceptable colour (8.86), appearance (8.60), flavour (8.60), taste (8.60), after taste (8.20), texture (7.93) and overall acceptability (8.20) scores and an acceptability index of T_3 of 93.65 percent was selected as the best treatment. Similarly, Nazni and Sangeethalakshmi (2017) [8] reported that idli with 75 percent millet barnyard millet had good sensory acceptance of 7.5.

Table 4 presents sensory scores and acceptability index of dosas prepared with different proportions of resistant starch rich browntop millet based health mix. Replacement of wheat flour with resistant starch rich browntop millet based health mix had significantly ($p \leq 0.01$) influenced colour, appearance, taste, after taste, flavour, texture and overall acceptability. Sensory scores ranged from 7.66 to 8.86 for colour, 7.73 to 9.00 for appearance, 7.00 to 8.60 for flavour, 7.12 to 8.60 for taste, 7.20 to 8.13 for after taste, 7.06 to 7.86 for texture and 7.00 to 8.20 for overall acceptability. Increasing the RS-BHM proportion to 25% (T_2) and 50% (T_3) had significantly ($p \leq 0.01$) increased colour, appearance, flavour, texture and overall acceptability scores. Sensory scores of T_4 (75% RS-BHM) with respect to taste, after taste, texture and overall acceptability were significantly ($p \leq 0.01$) lower compared to other treatments and with respect to color, appearance and flavour scores were significantly ($p \leq 0.01$) lower than T_2 and T_3 and were on par to T_1. Though scores of T_4 were lower compared to other treatments they were within acceptable range. Therefore, T_3 (dosa prepared with 50% RS-BHM and 50% wheat flour) with acceptable colour (8.86), appearance (8.73), flavour (8.60), taste (8.60), after taste (8.13), texture (7.86) and overall acceptability (8.20) scores and an acceptability index of 93.65 percent was selected as the best treatment. Similar results were reported by Vijayakumar and Mohankuma, (2011) [14], where dosa prepared with 75% millet composite flour had good acceptability of 80%.

Table 5. presents proximate composition of value added products with best accepted proportion of resistant starch rich browntop millet based health mix. From the table it is evident that chapati, soup, dosa and idli as good source of protein, total carbohydrates and energy. From the Table 5 it is evident that protein, total carbohydrates and energy values of chapati was 8.12 g, 72.49 g and 352 Kcal respectively. Protein, total carbohydrates and energy values of soup was 8.99 g, 68.48 g and 347 Kcal respectively.

Protein, total carbohydrates and energy values of soup was 8.99 g, 68.48 g and 347 Kcal respectively. Protein, total carbohydrates and energy values of idli was 9.23 g, 69.06 g and 359 Kcal respectively. Protein, total carbohydrates and energy values of dosa was 8.99 g, 66.63 g and 365 Kcal respectively.

Table 1: Sensory scores of chapati prepared with different proportions resistant starch rich browntop millet based health mix

Treatments	Proportion Wheat flour: RS-BHM	Color	Appearance	Flavour	Taste	After taste	Texture	Overall acceptability	Acceptability index
T_1	100:0	8.00±0.00^a	8.40±0.50^a	7.53±0.63^b	8.26±0.45^b	8.00±0.00^a	8.20±0.41^a	7.93±0.25^a	89.42
T_2	50:50	8.13±0.35^a	8.33±0.48^a	8.20±0.41^a	9.00±0.00^a	8.00±0.00^a	8.00±0.00^a	8.20±0.41^a	91.85
T_3	25:75	8.13±0.35^a	8.13±0.35^a	8.20±0.41^a	8.66±0.48^{ab}	8.00±0.00^a	8.00±0.00^a	8.00±0.00^a	91.32
T_4	0:100	8.13±0.35^a	7.33±0.48^b	8.26±0.45^a	8.40±0.50^b	7.06±0.25^b	7.00±0.00^b	7.80±0.86^a	85.71
F Value		0.71	16.87	7.46	8.92	196.02	102.66	1.14	-
CD value		NS	0.35**	0.18**	0.48**	NS	0.24**	NS	-
S.Em value		0.14	0.09	0.05	0.13	0.12	0.06	0.06	-

Note: Values are expressed as mean ± Standard deviation of fifteen replications, Values have different superscripts in a column are significantly different, values having same superscript in a column are not significantly different, CD: Critical Difference, SEm: Standard Error of Means, ** significant at 1% level, * significant at 5% level, NS: Not significant. RS: Resistant starch, RS-BHM: resistant starch rich heath mix, T1: No RS-BHM, T2: 50% RS-BHM, T3: 75 % RS-BHM, T4: 100 % RS-BHM

Table 2: Sensory scores of soups prepared with different proportions of resistant starch rich browntop millet based health mix

Treatments	Proportion Cornflour flour: RS-BHM	Color	Appearance	Flavour	Taste	After taste	Consistency	Overall acceptability	Acceptability index
T_1	100:0	7.13±0.35^d	7.00±0.00^c	6.73±0.45^d	7.53±0.51^d	7.66±0.48^{ab}	7.06±0.25^c	7.26±0.45^c	80.00
T_2	50:50	7.73±0.45^c	7.73±0.45^b	7.33±0.48^c	8.00±0.00^c	8.00±0.00^a	7.73±0.45^c	7.80±0.41^b	86.24
T_3	25:75	8.33±061^b	8.00±0.37^{ab}	8.13±0.35^b	8.40±0.50^b	8.13±0.35^a	8.13±0.51^b	8.46±0.51^a	91.43
T_4	0:100	9.00±0.00^a	8.33±0.48^a	9.00±0.00^a	9.00±0.00^a	8.06±0.25^a	9.00±0.00^{ab}	8.80±0.41^a	97.14
F Value		53.85	32.66	101.73	44.29	6.01	72.17	34.37	-
CD value		0.48**	0.44**	0.43**	0.41**	0.37**	0.42**	0.51**	-
S.Em value		0.13	0.12	0.11	0.11	0.10	0.11	0.14	-

Note: Values are expressed as mean ± Standard deviation of fifteen replications, Values have different superscripts in a column are significantly different, values having same superscript in a column are not significantly different, CD: Critical Difference, S Em: Standard Error of Means, **significant at 1% level, * significant at 5% level, NS: Not significant. RS-BHM: resistant starch rich browntop millet based health mix, T1: No RS-BHM, T2: 50% RS-BHM, T3: 75 % RS-BHM, T4: 100 % RS-BHM

Table 3: Sensory scores of idlis prepared with different proportions resistant starch rich browntop millet based health mix

Treatments	Proportion Idli rava: Blackgram: RS- BHM	Color	Appearance	Flavour	Taste	After taste	Texture	Overall acceptability	Acceptability index
T_1	25:75:0	7.66±0.48^b	8.00±0.00^b	7.00±0.00^c	7.73±0.45^b	7.86±0.35^a	7.80±0.41^a	8.00±0.00^a	85.82
T_2	25:50:25	8.73±0.45^a	8.80±0.41^a	8.00±0.00^b	8.00±0.00^b	7.90±0.59^a	7.86±0.51^a	8.13±0.35^a	91.22
T_3	25:25:50	8.86±0.51^a	8.60±0.50^a	8.60±0.50^a	8.60±0.50^a	8.20±0.41^a	7.93±0.45^a	8.20±0.41^a	93.65
T_4	25:0:75	7.33±0.48^b	7.60±0.50^b	7.26±0.45^c	7.00±0.75^c	7.33±0.48^b	6.73±0.79^b	7.06±0.25^b	79.89
F Value		26.52	38.84	25.43	67.57	8.93	15.12	46.36	-
CD value		0.55**	0.47**	0.38**	0.58**	0.53**	0.64**	1.08**	-
S. Em value		0.12	0.15	0.10	0.15	0.14	0.17	0.29	-

Note: Values are expressed as mean ± Standard deviation of fifteen replications, Values have different superscripts in a column are significantly different, values having same superscript in a column are not significantly different, CD: Critical Difference, SEm: Standard Error of Means, ** significant at 1% level, * significant at 5% level, NS: Not significant. RS-BHM: resistant starch rich browntop millet based health mix, T1: No RS-BHM, T2: 25%RS-BHM, T3: 50 % RS-BHM, T4: 75 % RS-BHM

Table 4: Sensory scores of dosa prepared with different proportions resistant starch rich browntop millet based health mix

Treatments	Proportion Wheat flour: RS-BHM	Color	Appearance	Flavour	Taste	After taste	Texture	Overall acceptability	Acceptability index
T_1	100+0	7.66±0.48^b	8.00±0.00^b	7.00±0.00^c	7.73±0.45^b	7.86±0.35^a	7.80±0.41^a	8.10±0.00^a	85.82
T_2	75+25	8.73±0.45^a	9.00±0.41^a	8.00±0.00^a	8.00±0.00^b	7.86±0.59^a	7.80±0.51^a	8.13±0.35^a	91.32
T_3	50+50	8.86±0.51^a	8.73±0.50^a	8.60±0.50^a	8.60±0.50^a	8.13±0.41^a	7.86±0.45^a	8.20±0.41^a	93.65
T_4	25+75	7.33±0.48^b	7.73±0.50^b	7.13±0.45^c	7.12±0.75^c	7.20±0.48^b	7.06±0.79^b	7.00±0.25^b	79.05
F Value		36.84	26.54	67.57	25.43	8.93	15.12	46.36	-
CD value		0.55**	0.47**	0.39**	0.58**	0.53**	0.64**	1.08**	-
S.Em value		0.15	0.12	0.10	0.15	0.14	0.17	0.29	-

Note: Values are expressed as mean ± Standard deviation of fifteen replications, Values have different superscripts in a column are significantly different, values having same superscript in a column are not significantly different, CD: Critical Difference, SEm: Standard Error of Means, ** significant at 1% level, * significant at 5% level, NS: Not significant. RS-BHM: resistant starch rich browntop millet based health mix, T1: No RS-BHM, T2: 25% RS-BHM, T3: 50 % RS-BHM, T4: 75 % RS-BHM

Table 5: Proximate composition of best accepted value added products from resistant starch rich browntop millet based health mix

Proximate composition	Chapati	Soup	Idli	Dosa
Moisture (%)	8.92	12.13	9.45	10.12
Protein (%)	8.12	8.99	9.23	8.99
Fat (%)	3.23	4.12	5.12	6.15
Ash (%)	4.12	3.29	3.68	3.99
Crude fibre (%)	3.12	2.99	3.46	4.12
Total carbohydrates (%)	72.49	68.48	69.06	66.63
Available carbohydrates (%)	69.37	65.49	65.6	62.51
Energy (Kcal)	352	347	359	365

Conclusion

Therefore, from the study it can be concluded that value added products from resistant starch rich browntop millet based health mix can be effectively used for the preparation of traditional products that have good sensory acceptance and nutritional profile.

References

1. Amerine MA, Pangborn RM, Roseller EB. Principles of sensory evaluation of food. Academic Press, London. 5, 1965,
2. Birt DF, Boylston T, Hendrich S, Jane J, Hollis J, Li Mcclelland J, *et al*. Resistant Starch: Promise for Improving Human Health. 2013;1(2):587-601.
3. Higgins, Janine A. Resistant Starch and Energy Balance: Impact on Weight Loss and Maintenance. Critical Reviews in Food Science and Nutrition. 2014;54(9):1158-1166.
4. Kaimal AM, Mujumdar AS, Thorat BN. Resistant starch from millets: Recent developments and applications in food industries. Trends in Food Science and Technology. 2021;111:563-580.
5. Keenan RJ, Ravussin E. Effect of 12 week of resistant starch supplementation on cardio metabolic risk factors in adults with: a randomized controlled trial. American Journal of Clinical Nutrition. 2018;108:492-501.
6. Longvah T, Ananthan R, Bharskaracharya K, Venakaiah K. Indian Food Composition Tables, National institute of nutrition, Hyderabad, India, 2017.
7. Mounika M, Hymavathi TV, Aparna K, Sreedhar R. Development, physical and sensory evaluation of chapatis (Indian flat bread) produced by utilising legumes, nutri-cereals and wheat flour. 2020;39(18):68-76.
8. Nazni P, Sangeethalakshmi T. Optimization of millet-based idli formulations using response surface methodology, Innovare Journal of Food Science. 2017;5(2):1-7.
9. Nichenametla SN, Weidauer LA, Wey HE, Beare TM, Specker BL, Dey M. Resistant starch type 4-enriched diet lowered blood cholesterols and improved body composition in a double-blind controlled cross-over intervention. Molecular Nutrition Food Research. 2014;58:1365-1369.
10. Park OJ, Kamg NE, Chnag MJ, Kim VK. Resistant Starch Supplementation Influences Blood Lipid Concentrations and Glucose Control in Overweight Subjects. Journal of Nutrition Science Vitaminology. 2004;50:93-99.
11. Peterson CM, Beyl RA, Marlatt KL, Martin CK, Aryana KJ, Marco ML, *et al*. Effect of 12 week of resistant starch supplementation on cardiometabolic risk factors in adults with prediabetes: A randomized controlled trial. American Journal of Clinical Nutrition. 2018;108:492-501.
12. Sharma B, Gujral HS. Influence of nutritional and antinutritional components on dough rheology and in vitro protein and starch digestibility of minor millets. Food Chemistry. 2019;299:125-115.
13. Sharma S, Singh K, Sharma U, Kumar R, Yadav N. Effect of thermal processing on anti-nutritional factors and in vitro bioavailability of minerals in desi and kabuli cultivars of chick pea grown in North India. Legume Research. 2018;41(2):267-274.
14. Vijayakumar TP, Mohankumar JB. Quality evaluation of dosa from millet flour blend incorporated composite flour. 2011;34(11):2624-2629.