International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 2043-2046

Received: 25-05-2017
Accepted: 26-06-2017

Kamalaja Thummakomma
Scientist- Foods and Nutrition, All India Coordinated Research Project on Home Science Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India

Prashanthi Meda
Research Associate-FN, All India Coordinated Research Project on Home Science Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India

Correspondence
Kamalaja Thummakomma
Scientist- Foods and Nutrition, All India Coordinated Research Project on Home Science Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India

Analysis of cooking effect on Bioactive compounds in cereals

Kamalaja Thummakomma and Prashanthi Meda

Abstract
Cereals have been the essential part of the human diet since the beginning of agriculture. Cereals are most economic source of energy. Cereals supply about 70-80% of energy requirements in Indian diet. Apart from nutrients like protein, fat, vitamins, and minerals, they contain bioactive compounds, which have received a great importance during these days due to their role in providing protection against lifestyle disorders such as cardiovascular diseases, cancer, etc. The present study aimed at studying the effect of cooking on biologically active compounds, in most commonly consumed cereals of Telangana state, i.e., rice, wheat, jowar, and ragi. Bioactive compounds of raw, open cooked, and pressure cooked cereals were analyzed and found the percent change in phenolic content from raw to open cooking ranged from 12 to -45 mg GAE/100g, raw to pressure phenols ranges from 3.6 to -49.0 mg GAE/100g. The percent change in flavonoid content of raw to open cooked ranged from 31 to -53(mg RE/100g) and raw to pressure cooked ranged from -44 to 33(mg RE/100g). The per cent change in antioxidant activity of cereals in FRAP method ranges from 4.3 to -36(mg TE/100 g) raw to open cooked and in pressure cooked the percent change ranges from 5.8 to -42(mg TE/100g), while in DDPH the per cent of AOA in raw to open cooked cereals raged from 3.8 to -59.8(mg TE/100 g) and raw to pressure cooked cereals ranged from 9.9 to -64.2(mg TE/100 g). And there was significant difference at 1% level was found among all cereals.

Keywords: Cereals; bioactive compounds; open cooking and pressure cooking; FRAP; AOA; DPPH; phenolics; flavonoids; antioxidants

1. Introduction

Cereals are the largest and most important constituent of the diet. Cereals and cereal products provide more than 56 per cent of the energy and 50 per cent of the protein consumed by humans worldwide [Goldberg G (2003)] [6]. Consumption of cereal grains forms the basis of a healthy diet, and all current dietary guidelines have cereal foods as the largest component of the recommended daily intake [National Health and Medical Research Council (2003)] [14]. They are rich sources of fiber, vitamins, minerals, and phytochemicals including phenolics, carotenoids, vitamin E, lignans, β-glucan, inulin, resistant starch, sterols, and phytates [Liu (2003), Liu (2004: and Slavin (2000)] [13, 12, 18]. Ferulic acid and diferulates are predominantly found in grains but are not present in significant quantities in fruits and vegetables [Bunzel *et al*. (2001)] [4]. All cereals have potential antioxidant properties. This is because of the presence of an aromatic phenolic ring that can stabilize and delocalize the unpaired electron within its aromatic ring [Rice-Evans *et al*. (1997)] [15]. They are believed to act mainly as free-radical scavengers, and/or chelators of transition metals (minerals or trace elements). Phytic acid in cereals can act by forming chelates and suppressing Fe-catalysed damaging redox reactions, or by suppressing the oxidative damage caused to the gut epithelium, particularly in the colon where bacteria also yield oxygenated radicals. Y-Oryzanol in rice is a mixture of different phytosteryl ferulates. It is specifically extracted from rice bran and is a powerful inhibitor of iron driven hydroxyl radical formation.

The major cereals consumed worldwide are wheat, rice, maize, barley, oats, rye, millet, sorghum. Apart from being an important part of diet, these cereals are also rich in various health promoting components [Slavin (2003)] [18].Bioactive compounds are extra nutritional elements that typically occur in small quantities in foods. These substances are beneficial to human health but are not essential for the human body [Kris *et al*. (2002)] [11]. Reactive oxygen species (ROS) such as singlet oxygen, superoxide anion, hydroxyl radical, and hydrogen peroxide (H2O2) are often generated as byproducts of biological reactions or from exogenous factors [Wiseman and Halliwell (1996)] [21].

These reactive species exert oxidative damage by reacting with nearly every molecule found in living cells including DNA [Cooke *et al*. (2003)] [5]. Excess ROS, if not eliminated by antioxidant system, result in high levels of free radicals and lipid peroxides which underlie the pathogenesis of degenerative diseases like atherosclerosis, carcinogenesis, diabetes, cataract, ageing, and so forth [Halliwell *et al*. (1992)] [7]. Experimental and epidemiological evidence suggests a significant role of diet in the prevention of degenerative diseases [Harris and Ferguson (1993)] [8]. Plant derived antioxidants, such as flavonoids and related phenolic compounds, have multiple biological effects, including antioxidant activity. Phytochemicals present in plant foods exert health beneficial effects, as they combat oxidative stress in the body by maintaining a balance between oxidants and antioxidants [Scalbert *et al*. (2005)] [16]. The cereals are cooked and consumed for easy digestibility and palatability. Different methods are followed for cooking these cereals. The common method of cooking is open and pressure cooking. As they constitute major part of our daily diet, the study was undertaken to study the effect of different methods of cooking on bioactive compounds.

2. Materials and Methods

Four most commonly consumed cereals in Telangana Sate, i.e. rice, ragi, wheat, and jowar, were selected for this study and they are procured from the local market.

Reagents used were methanol, 6N Hydrochloric acid, Whatman No. 1 filter paper, distilled water, Gallic acid (GA), Folin-Ciocalteu reagent, Sodium carbonate (7.5%), Rutin standard solution (10%), Sodium nitrite (5 gm %), Aluminium chloride (10 g %), Sodium Hydroxide (1N), Trolox standard solution (10 mg%):, Acetate Buffer (0.2M) (pH 3.6), Hydrochloric acid (400mM), TPTZ (2, 4, 6-tris (2-pyridyl)-s-triazine) (10mM), Ferric Chloride (hexahydrate) (20mM) (Freshly prepared), FRAP working reagent (Freshly prepared), Trolox standard solution (10 mg%), DPPH solution, Methanol.

Extraction of samples were done using 80% methanol acidified to pH 2.0 with 6N hydrochloric acid, for estimation of phenolics, flavonoids, and AOA in raw, open and pressuring cooking. Cooking was done using normal tap water.

Standard analysis procedures were followed for analysis for bioactive compounds in cereals, i.e.total phenolic content was analysed by singleton *et al* 1999 method, total flavonoids by Zhishen *et al*., 1999 method. DPPH Radical-Scavenging Activity by Tadhani *et al*. 2007 method and Ferric reducing antioxidant power (FRAP) was determined according to Benzie and Strain 1999 methods.

3. Results and discussion

3.1 Total phenols in cereals

Total phenolic contents of raw, cooked(open & pressure) extracts of cereals and their difference as compared to raw are presented in Table 1.The TPC of raw (C) extracts of cereals ranged from 381.5 to 42.0 mg GAE/100g. Ranking of cereals basing on TPC in cereals is ragi > jowar > wheat > rice.

Cereals are prepared for consumption after thermal and hydrothermal treatments. In this study, cereals like rice, wheat, jowar and ragi were cooked using boiling method for open cooking and pressure cooking for extraction. In our study, all the cereal samples showed a loss of TPC on cooking (open &pressure) except ragi. TPC of open cooked samples ranged from 427.7 to 23.1mg GAE/100g and pressure cooked samples ranged from 395.5 to 21.2 mg GAE/100g. Among all cereals -24.2 to -45.0 percent decrease in TPC was observed in rice and wheat, where as in jowar and ragi 40.0 to 12.0 percent increase was observed in open cooked cereals as compared to their raw counterparts. While in pressure cooked cereals -11.7 to -49.3 per cent decrease TPC was observed in wheat and rice, whereas jowar and ragi 30.4 to 3.6 per cent increases in TPC was observed in pressure cooked cereals when compared to raw. The total phenolic content cereals were compared with in the group and between the groups i.e. raw, open and pressure cooking showed significance difference at 1% level.

Table 1: Total Phenols in cereals (mg GAE/100 g)

S. No	Foods	Raw (control)	Open cooked (T1)	%Change	Pressure cooked (T2)	%Change	F-value
1	Jowar	139.94(±1.69)	196.53(±2.85)	40.44443	182.5(±3.43)	30.41375	343.0**
2	Rice	42.01(±1.46)	23.11(±0.95)	-45.0016	21.29(±0.6)	-49.3335	346.5**
3	Wheat	61.27(±2.65)	46.42(±1.55)	-24.2329	54.1(±2.8)	-11.7356	28.80**
4	Ragi	381.57(±0.87)	427.73(±1.04)	12.09922	395.55(±2.4)	3.663842	659.4**

3.2 Flavonoids in cereals

Flavonoid content of cereals largely varied from 10.01 mg (in rice) to 118.9 mg RE/100g (in ragi) in the raw (Control) extracts. According to the flavonoid contents of raw (Control) extracts, cereals ranked as ragi> wheat>jowar>rice. On open cooking (T1), losses occurred from -20.9 to -53.1% in different cereal samples except wheat which gained 31% flavonoid content when compared to raw cereals (Control). While pressure cooked extractions compared to control (raw cereals), the losses occurred from -4.4 to -49.02 in different samples except wheat which gained 33.9% flavonoid content. The total flavonoid of content cereals were compared with in the group and between the groups i.e. raw, open and pressure cooking showed significance difference at 1% level. Details are presented in table 2.

Table 2: Total Flavonoids in cereals (mg RE/100g)

S. No	FOOD	Raw (control)	Open cooking (T1)	%Change	Pressure cooking (T2)	%Change	F-value
1	Jowar	23.36±1.12	18.48±1.62	-20.9017	22.32±1.08	-4.46567	11.71**
2	Rice	10.57±1.04	4.95±1.82	-53.1861	5.39±2.32	-49.0221	8.97**
3	Wheat	25.62±1.03	33.61±2.21	31.21663	34.32±2.26	33.96226	18.9**
4	Ragi	118.9±1.39	69.62±2.01	-41.4297	78.96±2.22	-33.57	564.2**

3.3 Antioxidant activity

a) The FRAP (ferric reducing antioxidant power)

From table 3, highest AOA by FRAP was noticed in ragi (598.41 mg TE/100g) whereas rice observed lowest (21.82 mg TE/100g) when extracted by Control i.e. raw form. The ranking according to Control extracts is as follows: Ragi > Jowar > Wheat > Rice. Among all cereals only rice was lost AOA by -36% in open cooking, while reaming cereals gained AOA by 4.31% to 12.2% in open cooking.

On pressure cooking (T3), significant rise in FRAP of all cereals was observed except rice it deceased by -42.7 %, while ragi was gained highest antioxidant activity (15.3%) as compared to Control (raw). Other cereals increased their FRAP by 5.86% & 14.1%. The action of cooking is not much effected AOA of cereals when open and pressure cooking are compared.

The total AOA of content cereals by FRAP method were compared with in the group and between the groups i.e. raw, open and pressure cooking showed significance difference at 1% level except jowar it showed 5% level significant difference. Details are presented in table 3.

Table 3: AOA by FRAP (mg TE/100 g)

S. No	FOOD	Raw (control)	Open Cooking (T1)	%Change	Pressure Cooking (T2)	%Change	f- value
1	Jowar	52.36 (± 1.17)	54.62(±1.08)	4.316272	55.43(±1.32)	5.863254	2.29*
2	Rice	21.82(±1.32)	13.86(±2.14)	-36.4803	12.49(±2.32)	-42.7589	19.44**
3	Wheat	41.13(±0.96)	44.62(±1.98)	8.485291	46.93(±1.46)	14.10163	11.19**
4	Ragi	532.98(±1.32)	598.41(±1.01)	12.27626	615.01(±2.16)	15.39082	2274.4**

b) DPPH RADICAL SCAVENGING ABILITY

The DPPH of cereals ranged from 222.97 to 62.2 mg TE/100g when extracted in raw form (C). Ragi scored the highest radical scavenging activity (222.97 mg TE/100g) of all cereal samples in Control (C). Ranking of cereals for their DPPHRSA in their control extracts (raw form) is as follows: ragi > jowar > rice > wheat. Upon open cooking (T1), -13.80 to -59.8% lower radical scavenging were observed as compared to their control counterparts. On pressure cooking (T3), DPPH was ranging from 261.6 to 30.43 mg TE/100g. This increase created a difference of 9.94 % to -64.2% as compared to respective Control extracts i.e. raw form. All samples showed significant difference between DPPH of Control and pressure cooked T3 extracts (table 3).

Sreeramulu *et al* (2013) stated that the DPPH activity in cereals and millets ranged from 24–173 mg/100 g, with the highest activity being found in finger millet and the lowest in Semolina (wheat). The same result was similar with our study also.

The total AOA of content cereals by DPPH method were compared with in the group and between the groups i.e. raw, open and pressure cooking showed significance difference at 1% level. Details are presented in table 4.

Table 4: AOA in cereals by DPPH (mg TE/100 g)

S. No	FOOD	Raw (control)	Open Cooking (T1)	%Change	Pressure Cooking (T2)	%Change	f-value
1	Jowar	171.01(±1.79)	213.8(±1.93)	25.02	261.6(±0.67)	52.97	2513**
2	Rice	85.1(±2.42)	34.2(±0.91)	-59.81	30.43(±2.13)	-64.24	745.5**
3	Wheat	62.2(±1.72)	64.19(±2.02)	3.19	69.87(±1.19)	12.33	16.89**
4	Ragi	222.97(±1.66)	231.6(±1.11)	3.87	245.14(±2.43)	9.94	113.5**

4. Conclusion

From the study, it was found pressure cooking has a great impact on bioactive compounds, which can be suggested as a good cooking method, which saves not only time and fuel, but also conserves nutrients and one can get maximum benefit of nutrients.

5. References

1. Bender DA, Bender AE. Bender's Dictionary of Nutrition and Food technology, 7th edition. Woodhead Publishing, Abington, 1999.
2. Benzie IF, Strain JJ. Ferric reducing/antioxidant power assay: Direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. Methods in Enzymology. 1999; 299:15-27.
3. BNF (British Nutrition Foundation). Starchy Foods in the Diet. BNF, London, 1994.
4. Bunzel M, Ralph J, Marita JM, Hatfield RD, Steinhar H. Diferulates as structural components in soluble and insoluble cereal dietary fibre. Journal of the Science of Food and Agriculture. 2001; 81:653-660.
5. Cooke MS, Evans MD, Dizdaroglu M, Lunec J. Oxidative DNA damage: mechanisms, mutation, and disease. The FASEB Journal. 2003; 17(10):1195-1214.
6. Goldberg G. Plants: Diet and Health. The Report of the British Nutrition Foundation Task Force. Blackwell, Oxford, 2003.
7. Halliwell B, Gutteridge JMC, Cross CE. Free radicals, antioxidants, and human disease: where are we now?" Journal of Laboratory and Clinical Medicine. 1992; 119(6):598-620.
8. Harris PJ, Ferguson LR. Dietary fibre: its composition and role in protection against colorectal cancer. Mutation Research. 1993; 290(1):97-110.
9. Henry Zielinski, Halina Kozlowska, Bogdan Lewczuk. Bioactive compounds in the cereal grains before and after hydrothermal processing. Innovative Food Science & Emerging Technologies. 2001; 2:159-169.
10. Jeffery EH, Brown AF, Kurilich AC, *et al*. Variation in content of bioactive components in broccoli. Journal of Food Composition and Analysis. 2003; 16(3):323-330.
11. Kris-Etherton PM, Hecker KD, Bonanome A, Coval SM, Binkoski AE, *et al*. Bioactive compounds in foods: their role in the prevention of cardiovascular disease and cancer. American Journal of Medicine. 2002; 113(9B):71S-88S.
12. Liu RH. Potential synergy of phytochemicals in cancer prevention: mechanism of action. Journal of Nutrition. 2004; 134:3479S-3485S.

13. Liu S. Relation between changes in intake of dietary fiber and grain products and changes in weight and development of obesity in middle-aged women. American Journal of Clinical Nutrition. 2003; 78:517S-520S.
14. National Health and Medical Research Council, 2003.
15. Rice-Evans CA, Miller NJ, Paganga G. Structure-antioxidant activitiy relationships of flavonoids and phenolic acids. Free Radical Biology and Medicine. 1996; 20:933-956.
16. Scalbert A, Manach C, Morand C, Remesy C, Jimenez J. Dietary polyphenols and the prevention of diseases. Critical Reviews in Food Science and Nutrition. 2005; 45(4):287-306.
17. Singleton VL, Orthofer R, Lamuela-Raventos RM. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin- Ciocalteu reagent. Methods of Enzymology. 1999; 299:152-158.
18. Slavin J. Why whole grains are protective: biological mechanisms. Proceedings of the Nutrition Society. 2003; 62:129-134.
19. Sreeramulu D, Reddy CVK, Chauhan A, Balakrishna N, Raghunath M. Natural Antioxidant Activity of Commonly Consumed Plant Foods in India: Effect of Domestic Processing. Oxidative Medicine and Cellular Longevity. 2013; 1-12.
20. Tadhani MB, Patel VH, Subhash R. In vitro antioxidant activities of Stevia rebaudiana leaves and callus. Journal of Food Composition and Analysis. 2007; 20(3):323-329.
21. Wiseman H, Halliwell B. Damage to DNA by reactive oxygen and nitrogen species: role in inflammatory disease and progression to cancer. Biochemical Journal. 1996; 313(1):17-29.
22. Zhishen J, Mengcheng T, Jianming W. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chemistry. 1999; 64(4):555-559.