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Comparison of Nutritional Qualities and Antioxidant Properties of Ready–to-Eat Fruit-Enriched Corn Based Breakfast Cereals

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ABSTRACT

Introduction: The study aimed to analyse the nutritional quality, antioxidant components and activity of three varieties of corn based ready-to- eat (RTE) breakfast cereals (BFC) enriched with strawberry, banana and mango. **Methods:** Fruit-enriched corn based breakfast cereals manufactured in India were purchased and ground to obtain homogeneous samples for analysis. The contents of moisture, protein, total fat, dietary fibre, iron, phosphorous, calcium, vitamin C, total carotene, thiamine, riboflavin, *in vitro* digestible protein, bioaccessible calcium and iron, and digestible starch fractions were determined. The antioxidant components namely, polyphenols, flavonoids and antioxidant activity in different extracts were also determined using total antioxidant, free radical scavenging (2,2-diphenyl-1-picrylhydrazyl) and reducing power assays. **Results:** The protein and dietary fibre contents in all samples ranged between 4.0-4.6 and 6.4-7.6 g/100g respectively. Total iron and vitamin C ranged between 10.7-13.3 mg and 33.2-43.6 mg/100g respectively. Cereals with mango had high total carotene in comparison with other samples. *In vitro* digestible protein of the processed cereals was low, while bioaccessible calcium (50.2-59.5%) and iron (8.5-15.1%) levels were high due to low oxalates and phytic acid contents. The starch profiles of the breakfast cereals showed high rapidly available glucose and starch digestibility index. Fruit-enriched breakfast cereals showed high polyphenol content in methanol extract (48.6-71.3 mg/100g) and high total antioxidant activity in aqueous extracts. Free radical scavenging and reducing power assay showed high activity in 80% methanol extract. **Conclusion:** Fruit-enriched breakfast cereals have the potential to be a good source of iron, dietary fibre, vitamin C and total carotene. The fruit-enriched cereals also had high bioaccessible iron and antioxidant activity.

Keywords: Nutrient composition, anti-nutrients, starch digestibility, mineral bioaccessibility, antioxidants components

INTRODUCTION

Processing makes foods healthier, safer, tastier and more shelf-stable. While the benefits are numerous, processing can also be detrimental, affecting the nutritional quality of foods. Fortification of food is done either to make up for the nutrients lost during

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processing or to make the product more nutrient dense in order to meet the necessary calorie and nutrient requirement of the population.

Fortified foods have a strong market share of the shelves due to their role in health promoting aspects with one such commonly fortified food being breakfast cereals, which appear to be the most commonly eaten by children and adults regardless of age. Commercial cereals are usually extruded, puffed, flaked, or otherwise altered to make a desirable product. Most research findings suggest that processing of whole grains does not remove biologically important compounds (Slavin *et al.*, 2001) but rather improves their quality. Ready-to-eat (RTE) breakfast cereals are fortified by adding natural ingredients (fruits or cereals) and / or synthetic vitamins and minerals. Many studies have been done in this area in order to assess the efficacy of the added nutrients in breakfast cereals. It is well documented that addition of these fortificants show protective effect on body, especially the antioxidants, whose function is scavenging and minimising the formation of free radicals which otherwise cause oxidative damage *in vivo* thus paving way for chronic diseases, such as cancer and atherosclerosis (Ames, 1989). Adom & Liu (2002) suggest that the antioxidant potential of grains has been underestimated since only unbound antioxidants are usually studied. They also state that in wheat, 90% of the antioxidants are bound. Bound phytochemicals could survive stomach and intestinal digestion, but would then be released in the large intestine and potentially play a protective role. It was seen that corn had the highest antioxidant followed by wheat, oat and rice when various grains were compared. Another study reported on the analysis of processed breads and cereals and indicated that they are a rich source of antioxidants (Miller, Rigelhof & Marquart, 2000). Thus processing may open up the food matrix, allowing the release of tightly bound phytochemicals from the grain structure (Fulcher & Duke, 2002). Therefore fortification has beneficial effects on health and disease status provided the nutrients fortified in processed foods are stable and bioaccessible on storage with time, temperature and packaging materials.

Hence, the objective of this research study was to evaluate the nutritional composition, antinutrients content, bioaccessible iron and calcium, digestible protein and starch in three different varieties of fruit enriched corn based RTE breakfast cereals. The study also compared the antioxidant activity of processed cereals in different extracts like aqueous, ethanol, methanol and 80% methanol.

METHODS

Three varieties of RTE corn based breakfast cereals were selected and purchased from the supermarket namely, corn strawberry, corn banana and corn mango. Breakfast cereals were finely ground to obtain a homogenous material, which was used for further analysis. All the samples were analysed for proximate composition. The methodologies followed for different constituents were as follows: (i) moisture by hot air oven method at temperatures of 100 - 105°C (AOAC, 1990); (ii) protein by micro-Kjeldahl distillation and fat using solvent extraction by Soxhlet method (Raghuramulu, Nair & Kalayanasundaram, 2003); (iii)total dietary fibre by enzymatic gravimetric method (AOAC, 2000); (iv) iron and phosphorous by colorimetry (AOAC, 1965); and (v) calcium by titremetric method (Oser, 1965). Vitamins were also estimated; vitamin C by visual titration, total carotene, spectrophotometrically (Ranganna, 1986), and thiamin and riboflavin by fluoroscence methods (Raghuramulu *et al.*, 2003). *In vitro* protein digestibility of the RTE breakfast cereals was analysed by the method of Akeson & Stahmann (1964) and bio-accessible minerals like calcium and iron were determined by simulated gastrointestinal digestion using pepsin for gastric stage followed by pancreatin and bile for intestinal stage. The proportion of mineral diffused through a semipermeable membrane was used to measure mineral dialysability (Luten *et al.*, 1996). All analyses were carried out in triplicate. Antinutrients like total oxalates were determined by titremetric method (Baker, 1952), tannin content was measured spectrophotometrically (Ranganna, 1986) and phytic acid was extracted and determined according to supernatant difference method (Thompson & Erdman, 1982).

The RTE breakfast cereals were also studied for total starch content (TS) and its different fractions namely, rapidly digestible starch (RDS), slowly digestible starch (SDS) and resistant starch (RS). Starch digestibility index (SDI) and rapidly available glucose (RAG) were calculated taking into consideration the total starch content (Englyst *et al.*, 1992).

Antioxidant activity of RTE breakfast cereals was determined by dispersing finely ground samples in aqueous, ethanol, methanol and 80% methanol aqueous solution utilising three assay techniques namely (i)stable free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) which forms a deep purple solution, reacts with antioxidants and colour loss read at 515 nm (Singh, Murthy & Jayaprakasha, 2002), (ii)reducing power (Oyaizu *et al.*, 1986), and (iii)total antioxidant by phosphomolybdenum method (Prieto, Pineda & Aguilar, 1999). Antioxidant components like polyphenols were estimated as tannic acid equivalent (TAE) (Matthaus, 2002), total flavonoid as quercetin equivalent (QE) (Arvouet-Grand, Pourrat & Legret, 1994) and antioxidant yield of samples was estimated by dispersing the finely ground samples in different extracts and evaporating the extract to dryness and recording the weight.

Data were analysed statistically to determine mean ± SD for all values; analysis of variance (ANOVA) and student's *t*-test were used for determining inter-sample differences, if any. Correlation coefficient was used to determine the extent of association between antioxidant activity and antioxidant components.

RESULTS AND DISCUSSION

The three varieties of corn based RTE cereals had moisture ranging from 2.5 to 3.0%, fat between 0.5 to 2.0% and protein between 4.0-4.6 g/100g with a significant difference between corn mango and corn strawberry for protein content (Table 1). The analysed value for iron was in the range of 10.7 – 13.1 mg/100g with corn mango showing significantly higher content than corn banana or strawberry. The values were very high when compared to the unprocessed whole corn grain (1.1 mg /100g) (Gopalan *et al.*, 2000), thus indicating that its added iron and analysed values were as per the label. Total calcium content was very low in all the three varieties of breakfast cereals (11.2 to 14.8 mg /100g).

The vitamin profile of the breakfast cereals showed vitamin C to be high in corn mango (43.6 mg) but low in corn banana and corn strawberry (33.2 and 33.9 mg/100g) when compared to the label specifications. This could be due to externally added vitamin to the cornflakes, as the grains as such are a poor source of vitamin C. There was a significant difference between mango and other two cereals.

Corn mango also had high total carotene (3,096.9 µg/100g), which could be attributed to addition of fruit, since mango is a rich source of total carotene (2,743 µg/100g) (Gopalan *et al.*, 2000), followed by corn strawberry and corn banana, which were 189.8 and 173.3 µg/100g respectively. Anti-nutrients like phytate had a low value of between 15.1 to 27.1 mg/ 100g with a significant difference between samples; tannin was high (109.3 – 117.0 mg/ 100g) with a difference being seen between banana and the other two cereals, while total and

Table 1. Nutritional quality of RTE corn based breakfast cereals (per 100g)

Constituents	*Corn Strawberry*	*Corn Banana*	*Corn Mango*
Moisture (%)	3.0 ± 0.0	2.9 ± 0.1	2.5 ± 0.1
Protein (g)	4.0 ± 0.3[b]	4.3 ± 0.1[ab]	4.6 ± 0.0[a]
	(4.1)	(4.4)	(4.7)
Digestible protein (%)	22.7	18.0	15.5
Fat (g)[ns]	0.5 ± 0.0	2.0 ± 0.0	0.50 ± 0.0
	(0.5)	(2.1)	(0.5)
Carbohydrate by difference (g)	83.2	81.2	82.5
Dietary fiber (g) [ns]	6.9 ± 0.8	6.6 ± 0.3	7.5 ± 0.2
	(7.1)	(6.8)	(7.8)
Total Ash (g) [ns]	2.0 ± 0.0	2.0 ± 0.0	2.00 ± 0.0
	(2.1)	(2.0)	(2.0)
Iron (mg)	11.3 ± 0.0[b]	10.7 ± 0.0[b]	13.1 ± 0.6[a]
	(11.7)	(11.0)	(13.4)
Bioaccessible Iron (%)	8.3	8.7	15.8
Calcium (mg)	11.2 ± 0.0[b]	14.8 ± 0.9[a]	12.6 ± 0.0[b]
	(11.5)	(15.3)	(12.9)
Bioaccessible Calcium (%)	49.8	51.7	59.6
Phosphorous (mg)	43.9 ± 1.1[b]	42.6 ± 0.3[b]	46.5 ± 0.9[a]
	(45.3)	(43.8)	(47.7)
Vitamin C (mg)	33.9 ± 2.4[b]	33.2 ± 0.0[b]	43.6 ± 0.0[a]
	(34.9)	(34.2)	(44.7)
Total Carotene (µg)	185.8 ± 13.6[b]	160.8 ± 43.1[b]	3,096.9± 3.5[a]
	(191.6)	(165.6)	(3,176.4)
Thiamine (µg)*	ND	277.7 ± 2.3[b]	563.4 ± 3.0[a]
		(286.0)	(577.8)
Riboflavin (µg)	492.2 ± 30.8[b]	349.5 ± 12.5[c]	610.4 ± 0.7[a]
	(507.4)	(360.0)	(626.1)
Antinutrients			
Oxalic acid – Total (mg)	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0
	(0.1)	(0.1)	(0.1)
Oxalic acid –Soluble (mg)	ND	ND	ND
Phytate (mg)	19.9 ± 0.8[b]	27.1 ± 0.1[a]	15.1 ± 0.9[c]
	(20.5)	(27.9)	(15.4)
Tannin (mg)	111.2 ± 1.9[b]	117.0 ± 1.3[a]	109.3 ± 0.6[b]
	(114.6)	(120.5)	(112.1)

ND: not detected
[ns]: No significant difference between samples.
*: P < 0.000; highly significant on application of student's t-test.
Values are mean ± standard deviation. Figures in parenthesis represent values on a dry weight basis. Values with different superscripts indicate significant differences among samples on application of Tukey's test.

soluble oxalate was negligible in all the three varieties of breakfast cereals.

Bioaccessible iron and calcium of breakfast cereals were also determined using dialysis technique and the results are presented in Table 1. Calcium was found to be high in the range of 50.2 to 59.5 as percentage of total calcium, irrespective of the total calcium being low. This could be due to low phytic acid and oxalate content of the cornflakes. Presence of phytic acid and dietary fibre can adversely affect the bioaccessible iron and calcium as reported by Suma *et al.* (2007) for different varieties of rice flakes that are processed by treating paddy at high temperature.

High bioaccessibility of iron was seen in all the three varieties of breakfast cereals with the reange being 8.4 to 15.1% of total iron. Corn mango had the highest availability of iron, which could be due to higher vitamin C (43.6 mg / 100g) content of corn mango. Such an increase in bioavailability of iron by almost 30% on addition of fruit has been demonstrated in cereal, pulse and vegetable based diets by other authors (Lakshmi, Gupta & Prakash, 2006a). This enhancement of iron bioavailability could be attributed to both vitamin C and other organic acids present in fruits. In another study, Lakshmi, Gupta & Prakash (2006b) have also shown that when iron solution is treated with different organic acids like ascorbic, citric, malic and tartaric acid, addition of ascorbic acid will result in a tremendous increase in percent available iron in comparison to other organic acids. Hurrell *et al.* (2003) showed improved iron bioaccessibility when phytic acid was degraded in cereal porridges. Use of exogenous phytase completely degraded phytic acid during manufacture of roller-dried complementary foods based on rice, wheat, maize, oat, sorghum, and a wheat-soy blend, which was either reconstituted with water or milk. Iron absorption improved in cereal porridges prepared with water and not with milk due to phytate degradation.

Dietary fibre ranged closely in all the three varieties of breakfast cereals (6.6 to 7.5 g / 100g) with no significant difference; however, the analysed values were high compared to the label claim (1.7 to 3.0 g / 100g) (Table 1). Unprocessed corn is reported to have about 9.2 g and corn flakes about 4.0 g of dietary fibre per 100g (Souci, Fachmann & Kraut, 1994). The USDA Nationwide Food Consumption (1987-1988) and National Health and Nutrition Examination II (1976-1980) survey recommends that dietary fibre intake for children (older than 2 years) be computed by adding age in years plus 5 g / day (safe level) and age in years plus 10 g / day to

Table 2. Total starch, starch fractions, rapidly available glucose and starch digestibility index of RTE corn based breakfast cereal (g / 100g)

Breakfast Cereals	*% Dry matter*	*Starch profile*					
		Total	*Rapidly digestible*	*Slowly digestible*	*Resistant*	*Starch Digestibility Index*	*Rapidly available glucose*
Corn Strawberry	97.0	72.5 ± 0.1[b] (74.7)	58.7 ± 0.1[c] (60.5)	0.4 ± 0.0[c] (0.4)	13.3 ± 0.0[a] (13.7)	81.2 ± 0.1[c] (83.7)	70.3 ± 0.1[ab] (72.5)
Corn Banana	97.1	74.5 ± 0.0[a] (76.7)	63.0 ± 0.0[a] (64.9)	1.0 ± 0.0[b] (1.1)	10.5 ± 0.0[b] (10.8)	84.5 ± 0.1[b] (87.0)	70.3 ± 0.0[b] (72.4)
Corn Mango	97.5	70.2 ± 0.1[c] (72.0)	62.5 ± 0.0[b] (64.4)	3.6 ± 0.0[a] (3.7)	7.9 ± 0.1[c] (8.1)	89.1 ± 0.0[a] (91.4)	70.9 ± 0.1[a] (72.7)

Values are mean ± standard deviation. Figures in parenthesis represent values on a dry weight basis. Values with different superscripts indicate significant differences among samples on application of Tukey's test.

prevent chronic diseases and for normal laxation (Williams, Bollella & Wynder, 1995).

As breakfast is the first meal of the day, it is essential to measure the amount of glucose release after consumption, with emphasis being given if it is a processed food. Therefore, starch profile of breakfast cereals was studied (Table 2) to know the impact of extrusion cooking on starch digestibility. All three varieties of breakfast cereals showed significant differences between samples for TS, RDS, SDS, RS, SDI and RAG. Total starch content was between 70.2 to 74.5 g / 100g with high RAG and SDI in the range of 70.3 to 70.9 g and 81.2 to 89.1 g / 100g respectively. This is due to high RDS (58.7 – 63 g / 100g) and low SDS and RS (7.9 – 13.3 g / 100g). This is well explained by Englyst *et al.* (2003) in their study on glycemic index of cereal products, which explains the effects of processing techniques (thermal processing, extrusion cooking, autoclaving etc.) on starch modification. Breakfast cereals like cornflakes (58 g per serving) had RS content of 2.3, RAG, 45.4 and SAG 1.8 g / serving, whereas biscuits had RS content of 1.7, RAG, 32.8 and SAG, 2.6 per serving (65 g). This shows that heating in the presence of moisture in breakfast cereals, results in the gelatinisation of starch and consequently rapid digestion and high GI values. But biscuits that are baked under low moisture restrict the extent to which starch granules are gelatinised. Hence biscuits have high slowly available glucose (SAG). Therefore high GI (glycemic index) foods will show a low content of SAG than low GI food, which will have higher proportion of SAG. Therefore, it can be said that SAG is influenced by the food processing technique.

Fruits are a rich source of natural antioxidants and the antioxidant system is very important in maintaining the oxidative / antioxidative balance in the human body. Cereals like sorghum have exceptionally high antioxidant activity followed by millet and barley (Ragaee, Abdel-Aal & Noaman, 2006). Apart from natural sources of antioxidants such as fruits that contain about 1230 Trolox equivalents / 100g (TE), which average nearly three times the antioxidant concentration of vegetables, whole grain oat and wheat cereals contain about 2600 TE and 2900 TE respectively (Miller *et al*., 2000), more than from refined rice or corn (1300 TE). Fortification of breakfast cereals with fruits may also increase their antioxidant activity, which can be another potential source of dietary antioxidants. Yield of antioxidant material as found in Table 3 was obtained from different extracts for all the three varieties of breakfast cereals; aqueous extract showed high values ranging from 39.0 – 39.9 g / 100g followed by 80% methanol extract (34.4 – 38.5 g / 100g), methanol extract (14.3 – 15.6 g / 100g) and least in ethanol extract (8.0 – 8.8 g / 100g).

Extracts from the RTE breakfast cereals were evaluated for antioxidant activity and its components in four different extracts namely aqueous, ethanol, methanol and 80% methanol extracts as seen in Table 3. Polyphenol content was high in methanol extract (48.6 - 71.3 mg / 100g), followed by aqueous extract (51.6 - 64.7 mg / 100g), 80% methanol (44.1 - 57.5 mg / 100g) and very low in the ethanol extract (18.0 - 26.3 mg / 100g). Among the three varieties of breakfast cereals, corn banana and corn strawberry had the highest value. Flavonoid content was negligible in aqueous extract but found in low amounts in the other three (80% methanol, ethanol and methanol) extracts as well.

Total antioxidant activity was high in all the three varieties of breakfast cereals and in all the extracts; however corn banana in aqueous extract showed the highest antioxidant activity of 40,166.7 µmoles / g of sample followed by corn mango (38,223.3 µmoles / g) and corn strawberry (33,774.5 µmoles / g). A very high positive correlation was found between flavonoids and total antioxidant activity (TAA) in corn banana (R^2 : 0.999)(Table 3), and between polyphenol and TAA in corn strawberry (R^2 : 0.825). The TAA of corn mango was also positively

Table 3. Antioxidant yield, polyphenol and flavonoid content, total antioxidant activity in different extracts & correlation coefficient of RTE corn based breakfast cereals.

Breakfast cereals	*Aqueous extract*	*Ethanol extract*	*Methanol extract*	*80 % Methanol extract*
Antioxidant yield (g/100g)				
Corn Strawberry	39.9	8.6	15.4	38.5
Corn Banana	39.1	8.0	14.3	34.4
Corn Mango	39.0	8.8	15.6	36.7
Polyphenols (as TAE mg/100g)				
Corn Strawberry	64.7 ± 0.5(66.7)	18.0 ± 0.0(18.6)	48.6 ± 1.0(50.1)	57.5 ± 1.3(59.2)
Corn Banana	50.9 ± 0.1(52.4)	23.1 ± 0.1(23.8)	71.3 ± 0.4(73.4)	44.5 ± 0.0(45.8)
Corn Mango	51.6 ± 0.0(52.9)	26.3 ± 0.2(26.9)	51.7 ± 1.4(52.9)	44.1 ± 0.1(45.2)
Flavonoid (as QE mg/100g)				
Corn Strawberry	ND	24.7 ± 0.5(25.5)	7.50 ± 0.0(7.7)	20.3 ± 0.6(20.6)
Corn Banana	ND	21.0 ± 0.0(21.6)	ND	39.7 ± 0.6(41.0)
Corn Mango	ND	15.9 ± 1.0(16.3)	ND	7.5 ± 1.0(7.7)
Total Antioxidant activity (μ moles of ascorbic acid/g)				
Corn Strawberry	33,774.5 ± 84.9 (34,819.1)	18,431.7 ± 106.2 (19,001.7)	24,583.4 ± 84.9 (25,343.7)	23,223.0 ± 21.2 (23,941.3)
Corn Banana	40,166.7 ± 144.3 (41,361.3)	17,181.5 ± 42.5 (17,694.6)	21,235.4 ± 140.8 (21,869.6)	24,448.6 ± 382.1 (25,178.6)
Corn Mango	38,223.3 ± 479.2 (39,203.3)	14,595.8 ± 254.9 (14,970.1)	19,032.1 ± 92.6 (19,520.1)	24,485.4 ± 63.6 (25,113.2)

Correlation coefficient* (R^2 values)

	Components	*Antioxidant assay*		
		Total antioxidant activity	*Reducing power*	*DPPH*
Corn Strawberry	Polyphenols	0.825	0.639	0.827
	Flavonoids	- 0.671#	0.421#	0.393
Corn Banana	Polyphenols	0.259	0.118	-0.258
	Flavonoids	0.999#	0.998#	0.999#
Corn Mango	Polyphenols	0.642	0.430	0.237
	Flavonoids	-0.987#	-0.986#	-0.987#

* Correlation coefficient shows association between antioxidant activity and antioxidant components.
ND: not detected. #: Since flavonoid content was not detected in aqueous and methanol extract, samples were correlated for 80% methanol and ethanol except for corn strawberry, where methanol extract was used along with the above two extracts.

associated with polyphenol, though to a lesser extent.

Antioxidant activity was determined by stable free radical assay using 2,2-diphenyl-l-picrylhydrazyl (DPPH), which forms a deep purple solution. As seen in Figure 1, 80% methanol extract of the RTE breakfast had highest activity of about 50.5% at 20 mg/ml in corn strawberry and 45.1% and 48% in corn banana and corn mango respectively. In the aqueous extract, corn strawberry had 66% activity and corn banana showed comparatively less (51%) at the highest concentration of 40 mg/ml. But in the ethanol extract, as the concentration increased, activity also increased; in the methanol extract, the highest activity was 41.4% in corn strawberry, 37% in corn mango and 23% in corn banana at 40 mg/ml. On analysing the data for correlation coefficient (Table 3), a highly positive correlation (R^2: 0.999) was found between flavonoid and DPPH activity in corn banana and polyphenol and DPPH activity in corn strawberry (R^2: 0.826). According to Miller *et al.* (2000), 41 g of average serving of RTE breakfast cereal provides 1120 TE, while an average 85g serving of vegetables or fruits provides 380 and 1020 TE, respectively.

The conversion of ferric to ferrous in the presence of antioxidants as measured by reducing power assay was found to be high for corn mango in all the four extracts and revealed a positive correlation in flavonoids for corn banana. However, 80% methanol extract had the highest OD of 1.47 in corn mango, 1.51 in corn banana and 1.03 in corn strawberry and the lowest OD was seen in ethanol extract as shown in Figure 2.

CONCLUSION

Considering that the Indian diet consists predominantly of cereal grains, which is one of the contributors to daily carbohydrate intake, its processed products must provide quality nutrients with better nutrient availability. Addition of fruits (strawberry, banana and mango) to corn based breakfast cereals showed enhanced dietary fibre, vitamins (vitamin C & total carotene) and mineral (total iron), and high mineral (iron) bioaccessibility. Though processing improved the nutrient profile, its effect on starch digestibility with respect to available glucose was high indicating high GI. Therefore improved processing techniques that can result in a high content of slowly digestible starch in order to achieve low GI products must be explored.

Unprocessed cereals show fair amounts of antioxidant properties but processed cereals like breakfast cereals, which are enriched with fruits show high antioxidant activity which is again a boon to the processed food market. Therefore breakfast cereals can be considered as a good supplement for natural fruits and vegetables in processed foods like cereals that deliver superior nutrients.

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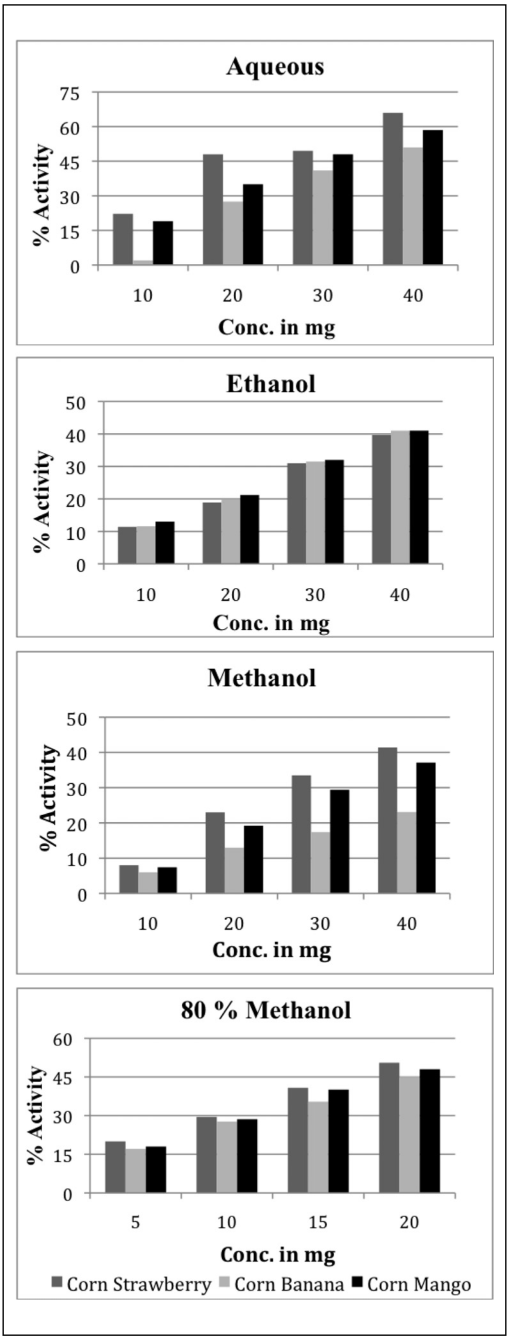

Figure 1. Free radical scavenging activity of RTE breakfast cereals in different extracts (mg / ml)

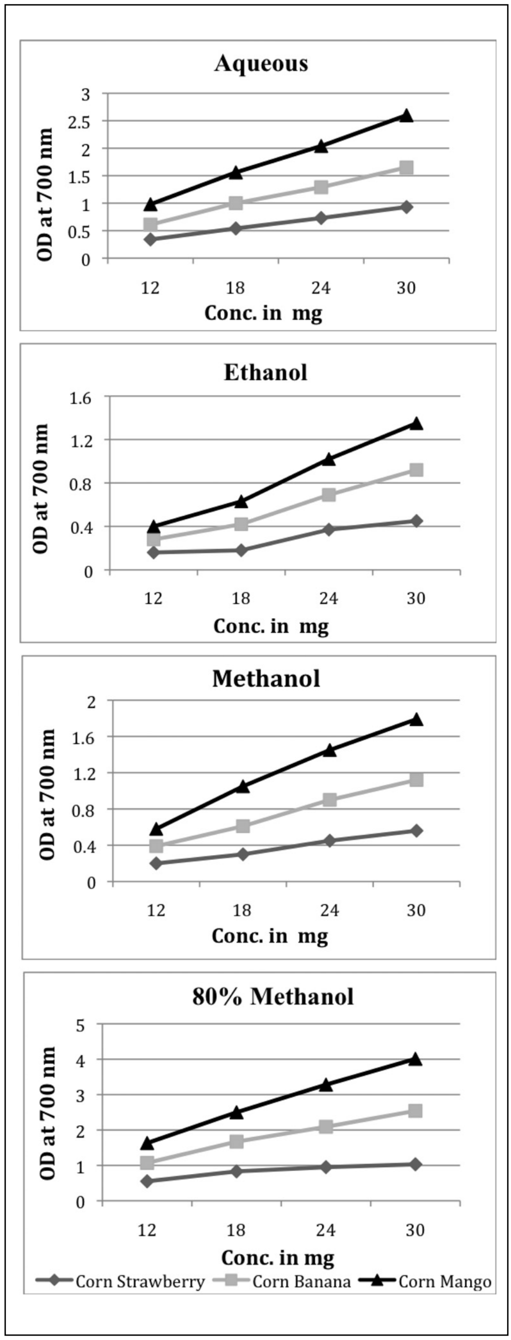

Figure 2. Reducing power of RTE breakfast cereals in different extracts (mg / ml)

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