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RESEARCH PAPER

Chemical and Mineral Composition of Defatted Flaxseed Flour Incorporated Crackers

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Abstract

The suitability of defatted flaxseed flour for cracker preparation was investigated in this study. The defatted flaxseed flour was blended with refined wheat flour in the ratios of 100:0, 95:5, 90:10, 85:15, 80:20, 75:25 and 70:30. The developed products were packed in laminate aluminium pouches and stored for 90 days at room temperature to ascertain the changes in chemical and mineral composition. From the results it was concluded that with the incorporation of roasted and partially defatted flaxseed the mean antioxidant activity was 33.87%, total phenolic content 113.33 mg/100g, free fatty acid 0.57% as oleic acid and peroxide value 0.29 meq. peroxide/kg of sample were observed the highest in treatment S_7 (30% flaxseed flour). However, minimum mean calcium and potassium content of 491.64 and 94.59 mg per 100 g were recorded in S_1 (0% flaxseed flour), respectively. In general, with the incorporation of roasted and partially defatted flaxseed flour, all the chemical parameters increased whereas, with the advancement of storage period decreased.

Keywords: Mineral, phytic acid, antioxidant activity, tannin, phenols

Consumers are increasingly interested in functional foods which has led to a greater supply of such products in the market. In the area of bakery products this trend is still relatively underdeveloped (Siro *et al*., 2008). Therefore, different alternative crops (amaranth, quinoa, flaxseed, etc.), as raw materials, are in focus for development of new bakery products. In this direction, flaxseed has assumed a great importance in the world's food chain as a functional food. Presently, flaxseed has new prospects as a functional food because of consumer's growing interest for food with superb health benefits. Owing to its excellent nutritional profile and potential health benefits, it has become an attractive ingredient in the diets specially designed for specific health benefits (Oomah, 2001).

Flaxseed contains several valuable nutritional compounds such as alpha linolenic acid, lignin, and dietary fibre (Daun *et al.,* 2003). It has also been reported to lower low density lipo-protein, cholesterol, which has been attributed to the high content of fibre components. Flaxseed is recognized as a good source of soluble fibres that helps lower blood cholesterol, insoluble fibre that promote laxation, alpha linolenic acid and essential omega-3 fatty acids important for cardiovascular health and phytoestrogens beneficial in post-menopausal women (Payne, 2000). Ground flaxseed is also high in omega-3 fatty acids, which have been shown to reduce hypertension, cholesterol and triglyceride level. The proximate composition of flaxseed indicates that it contains 30% protein, 35% lipids, 4% ash, 35% fibre and 6% carbohydrates.

Flaxseed has an amino acid profile comparable to that of soybean flour but contains no gluten. Moreover, flaxseed is a good source of high quality protein, soluble fibers and phenolic compounds (Oomah, 2001).

In comparison to most frequently used cereals, flaxseed flour has been reported to posses higher antioxidant activity and high quality protein. However, flaxseed as a food ingredient is not very familiar due to lack of awareness. Hence, there is a need to promote the utilization of flaxseed in day-to-day life owing to its health promoting characteristics. The popular and widely consumed bakery products can be effective carriers of functional ingredients. Therefore, the present study was conducted to investigate the effect of roasted and defatted flaxseed flour on the chemical and mineral composition of blended crackers during storage.

MATERIALS AND METHODS

Raw materials

The flaxseed grains and refined wheat flour (*maida*) were procured from local market. The flaxseed grains were then roasted for 3 minutes in household microwave oven at 450 watts and then, defatted in oil expeller to reduce oil, finally cooled and milled into flour.

Preparation of crackers

For preparation of crackers refined wheat flour and roasted defatted flaxseed flour was blended in the ratios as given below:

Treatments code	Refined wheat flour (%)	Flaxseed flour (%)
S_1	100	—
S_2	95	5
S_3	90	10
S_4	85	15
S_5	80	20
S_6	75	25
S_7	70	30

Crackers were prepared from blends of wheat-flaxseed flour and other ingredients (water, baking powder, shortening, cheese, salt and sugar) according to formulation described by Kohajdova *et al.* (2013). Fine wheat flour was used for preparation of control crackers. Preparation of crackers included these operations: mixing of dry and liquid ingredients, 10 minutes resting of dough, sheeting and cutting into square shape. The crackers were baked in three deck oven at 210 °C for 8 to 10 minutes and cooled to room temperature.

Chemical composition of blended crackers

Free fatty acid (AACC, 1990)

Ground samples (5 g) were taken to determine the free fatty acids. To the sample in stoppered flask benzene (50 ml) was added and kept for 30 minutes with frequent shakings. After filtration, measured aliquot (10 ml) of supernatant liquid was added with equal amount of alcohol (95%) and few drops of indicator and titrated against 0.02 N KOH, till permanent pale colour persisted.

Peroxide value

Standard AOAC (2005) procedure was followed to determine peroxide value of sample.

Antioxidant activity

Free radical scavenging activity was determined by DPPH (Di phenyl picryl hydrazyl) method. Five hundred micro liters of 0.5 mM DPPH solution and 2 ml of 80% of methanol aqueous solution were mixed with 25 micro liters of methanolic extract of sample and absorbance was determined under 517 nm (blank as 80% methanol and tris buffer) after maintaining at 20°C for 30 minutes. The free radical scavenging activity was evaluated by comparing the absorbance of the sample solution with control solution to which distilled water was added instead of sample (Koga *et al*., 2007).

Total phenols, Phytic Acid and Tannins

Total phenols and Phytic acid content were estimated by the standard methods of described by Sadasivam

and Manickam (2008). Tannin content was determined by the Folin-Denis method (Sadasivam and Manickam, 2008). A standard curve was prepared using tannic acid and tannin concentration was expressed in mg per 100 g.

Minerals

The organic matter present in the sample (1g) was wet digested with 25 ml of di-acid mixture (HNO_3: $HClO_4$ in 5:1) and kept overnight. Digestion was done next day by heating till clear white precipitates settled down at the bottom. The crystals were dissolved by diluting in double distilled water. The contents were filtered through Whatman filter paper no. 42. The filtrate was made upto the volume of 25 ml with double distilled water. The digested samples were analyzed for the determination of calcium, iron, sodium and potassium content using Atomic Absorption Spectrophotometer as per AOAC (2005) method.

RESULTS AND DISCUSSION

Free fatty acids

Table 1 shows the effect of various treatments and storage period on free fatty acid content of blended crackers. The data revealed that the treatments significantly influenced free fatty acid content of crackers, whereas, there were non-significant variations in free fatty acid content during storage. At the beginning, treatment S_7 (30% flaxseed flour) recorded the highest value of 0.40%. The lowest free fatty acid content of 0.30% was recorded in treatment S_1 (0% flaxseed flour) at 0 day storage. After 90 days of storage, S_7 (30% flaxseed flour) recorded the maximum (0.71% as oleic acid) free fatty acid content however, minimum (0.57%) was observed in (0% flaxseed flour). Storage non significantly increased the free fatty acid content. This is in accordance with the findings of Kaur (2011) who reported that free fatty acid content showed an increasing trend with storage of cookies.

Peroxide value

Table 1 illustrates the effect of various treatments and storage period on peroxide value of blended crackers. At 0 day storage, the highest peroxide value of 0.27% was recorded in S_7 (30% flaxseed flour) and lowest of 0.13% in S_1 (0% flaxseed flour). As the storage period advances, there was increase in peroxide value. There was a non-significant increase in the peroxide value

Table 1: Effect of treatment and storage on free fatty acid (%) and peroxide value (meq. peroxide/Kg of sample) of flaxseed flour blended crackers

Treatment	Free fatty acid (%) Storage Period (days)					Peroxide value (meq. peroxide/Kg of sample) Storage Period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
S_1 (100:00 :: RWF :PDRFF)	0.30	0.42	0.49	0.57	0.44	0.13	0.15	0.17	0.21	0.16
S_2 (95 :05 :: RWF :PDRFF)	0.32	0.43	0.51	0.58	0.46	0.15	0.16	0.19	0.23	0.18
S_3 (90 :10 :: RWF :PDRFF)	0.33	0.45	0.53	0.61	0.48	0.17	0.18	0.21	0.24	0.20
S_4 (85 :15 :: RWF :PDRFF)	0.36	0.48	0.55	0.63	0.50	0.20	0.21	0.24	0.26	0.22
S_5 (80 :20 :: RWF :PDRFF)	0.37	0.50	0.58	0.66	0.52	0.22	0.23	0.26	0.29	0.25
S_6 (75 :25 :: RWF :PDRFF)	0.39	0.53	0.60	0.68	0.55	0.25	0.26	0.29	0.31	0.27
S_7 (70 :30 :: RWF:PDRFF)	0.40	0.55	0.63	0.71	0.57	0.27	0.28	0.31	0.33	0.29
Mean	0.35	0.48	0.55	0.63		0.19	0.20	0.23	0.26	

Effect	C.D. (P=0.05)	C.D. (P=0.05)
Treatment	0.04	0.02
Storage	N.S	N.S
Treatment × Storage	N.S	N.S

of crackers from 0 day to 90 days of storage. The mean peroxide value increased from 0.19% at 0 day of storage to 0.26% after 90 days of storage. Similar results regarding increase in peroxide value has been reported by Kaur (2011) in flaxseed blended bread.

Total phenols

The results on the total phenolic content of blended crackers are presented in Table 2. It is evident from the results that total phenolic content of all the treatments increased significantly with the increase in the level of partially defatted roasted flaxseed flour incorporation in refined wheat flour. At 0 day, the highest phenolic content of 125.89 mg per 100 g was observed in S_7 (30% flaxseed flour) whereas, the lowest value of 81.35 mg per 100 g was recorded in treatment S_1 (0% flaxseed flour). The mean value of total phenolic content decreased from 103.46 mg per 100g at 0 day of storage to 79.93 mg per 100g after 90 days of storage. Similar results have been reported by Sedej *et al*. (2011) in buckwheat crackers.

Antioxidant activity

A glance at data in Table 2 revealed that with the incorporation of flaxseed flour, the antioxidant activity increased. At the beginning, treatment S_7 (30% flaxseed flour) recorded the highest antioxidant activity of 41.19%. On the other hand, after 90 days of storage, treatment S_1 (0% flaxseed flour) recorded the lowest value of 10.95%. Storage period significantly affected the antioxidant activity of blended crackers. During storage, there was a significant decrease in antioxidant activity of crackers. Total phenol have been reported to be responsible for the antioxidant activity. The antioxidant activity of phenolic compound is due to their ability to scavenge free radicles, donate hydrogen atoms or electrons, or chelate metal cations (Amarowicz *et al*., 2004). Similar trend of decrease in antioxidant activity during storage has been reported by Betsy (2011) in gluten-free cookies.

Phytic acid

A perusal of data in Table 3 indicated that the treatments significantly influenced phytic acid content of crackers. At 0 day of storage, treatment S_7 (30% flaxseed flour) recorded the highest phytic acid content of 296.73 mg per 100g whereas, the lowest value of 178.07 mg per 100g was recorded in S_1 (0% flaxseed flour). However, after 90 days of storage

Table 2: Effect of treatment and storage on total phenol (mg/100g) and antioxidant activity (%) of flaxseed flour blended crackers

Treatment	Total phenol (mg/100g) Storage Period (days)					Antioxidant activity (%) Storage Period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
S_1 (100:00 :: RWF :PDRFF)	81.35	75.38	68.41	59.63	71.19	24.80	20.93	14.63	10.95	17.82
S_2 (95 :05 :: RWF :PDRFF)	87.16	81.88	74.33	65.50	77.21	27.65	22.13	17.11	13.68	20.14
S_3 (90 :10 :: RWF :PDRFF)	95.60	89.62	82.27	73.46	85.23	31.00	26.57	20.56	17.24	23.84
S_4 (85 :15 :: RWF :PDRFF)	103.72	96.94	89.48	80.98	92.78	34.10	30.45	24.07	20.83	27.36
S_5 (80 :20 :: RWF :PDRFF)	111.50	104.73	95.96	87.04	99.80	36.96	32.06	26.24	22.51	29.41
S_6 (75 :25 :: RWF :PDRFF)	119.04	112.27	102.89	93.35	106.88	39.02	34.23	28.97	24.08	31.57
S_7 (70 :30 :: RWF:PDRFF)	125.89	118.76	109.12	99.58	113.33	41.19	36.74	31.45	26.13	33.87
Mean	103.46	97.08	88.92	79.93		33.53	29.05	23.29	19.34	

Effect	C.D. (P = 0.05)	C.D. (P=0.05)
Treatment	0.04	0.04
Storage	0.03	0.03
Treatment × Storage	0.09	0.08

Table 3: Effect of treatment and storage on phytic acid and tannin content (mg/100g) of flaxseed flour blended crackers

Treatment	Phytic acid (mg/100g)					Tannin (mg/100g)				
	Storage Period (days)					Storage Period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
S_1 (100:00 :: RWF :PDRFF)	178.07	176.67	173.83	171.35	174.98	208.16	201.53	195.37	188.21	198.31
S_2 (95 :05 :: RWF :PDRFF)	193.42	191.53	188.91	186.72	190.14	215.38	207.41	199.03	185.12	201.73
S_3 (90 :10 :: RWF :PDRFF)	215.36	212.95	209.67	207.81	211.44	223.46	215.22	207.84	201.93	212.11
S_4 (85 :15 :: RWF :PDRFF)	231.24	229.16	226.45	223.07	227.48	229.51	221.64	215.13	208.25	218.63
S_5 (80 :20 :: RWF :PDRFF)	250.68	247.88	245.59	242.60	246.68	234.67	227.35	220.53	212.06	223.65
S_6 (75 :25 :: RWF :PDRFF)	274.15	272.10	269.30	266.85	270.60	240.35	233.62	226.28	219.74	229.99
S_7 (70 :30 :: RWF:PDRFF)	296.73	294.83	291.75	288.64	292.98	246.25	240.17	234.62	227.15	237.04
Mean	234.23	232.16	229.35	226.72		228.25	220.99	214.11	206.06	

Effect	C.D. (P=0.05)	C.D. (P=0.05)
Treatment	0.04	0.04
Storage	0.03	0.03
Treatment × Storage	0.08	0.08

treatment S_1 (0% flaxseed flour) recorded the lowest value of 171.35 mg per 100g and highest value of 288.64 mg per 100g was observed in S_7 (30% flaxseed flour). There was a significant decrease in the phytic acid content from 0 day to 90 days of storage. During storage, phytase hydrolyze phytate to inorganic phosphorus. Phytase activity decreased during storage but retained sufficient activity to continue phytate hydrolysis throughout the storage period (Chita, 1994).

Tannins

The data pertaining to tannin content of blended crackers in Table 3 depicted a significant increase in tannin content with the incorporation of flaxseed flour. At the beginning, the highest tannin content (246.25 mg/100g) was recorded in treatment S_7 (30% flaxseed flour) whereas, the lowest value of 208.16 mg per 100g was observed in treatment S_1 (0% flaxseed flour).

After 90 days of storage, treatment S_7 (30% flaxseed flour) recorded the highest value of 227.15 mg per 100g whereas, the lowest tannin content of 188.21 mg per 100g was recorded in S_1 (0% flaxseed flour). The tannin content of crackers decreased significantly with the increase in the storage period. The decrease in assayable tannins may be due to changes in the solubility of tannins due to increased polymerization and decreased solubility (Salunkhe *et al*., 1990).

Calcium

Table 4 shows the effect of various treatments and storage period on calcium content of crackers. At the beginning, treatment S_7 (30% flaxseed flour) recorded the highest value of 579.59 mg per 100g. The lowest calcium content of 498.15 mg per 100g was recorded by treatment S_1 (0% flaxseed flour) at 0 day storage. On the other hand, after 90 days of storage S_7 (30% flaxseed flour) recorded the highest calcium content of 552.95 mg per 100 g and lowest (485.73 mg/100g) was observed in S_1 (0% flaxseed flour). There was a significant decrease in the calcium content of crackers from 0 to 90 days of storage. The mineral content were found to decrease with storage. Similar results have been reported by Mosha *et al*. (2010) in cassava based composite crackers.

Iron

The effect of various treatments and storage on iron content of crackers is presented in Table 4. The data revealed that the iron content of crackers was significantly influenced by different treatments and

Table 4: Effect of treatment and storage on calcium and iron content (mg/100g) of flaxseed flour blended crackers

Treatment	Calcium (mg/100g)					Iron (mg/100g)				
	Storage Period (days)					Storage Period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
S_1 (100:00 :: RWF :PDRFF)	498.15	493.23	489.46	485.73	491.64	6.18	6.15	6.10	6.07	6.12
S_2 (95 :05 :: RWF :PDRFF)	511.26	506.34	502.53	497.85	504.49	6.56	6.53	6.48	6.45	6.50
S_3 (90 :10 :: RWF :PDRFF)	523.50	517.26	514.21	509.24	516.05	6.81	6.78	6.70	6.67	6.74
S_4 (85 :15 :: RWF :PDRFF)	537.72	530.99	526.73	520.78	529.05	7.09	7.06	6.99	6.95	7.02
S_5 (80 :20 :: RWF :PDRFF)	550.00	543.26	539.20	533.20	541.41	7.33	7.29	7.21	7.16	7.24
S_6 (75 :25 :: RWF :PDRFF)	565.11	557.37	552.48	545.48	555.11	7.69	7.64	7.58	7.54	7.61
S_7 (70 :30 :: RWF:PDRFF)	579.59	568.86	563.95	552.95	566.33	7.96	7.90	7.82	7.78	7.86
Mean	537.90	531.04	526.93	520.74		7.08	7.05	6.98	6.94	

Effect	C.D. (P=0.05)	C.D. (P=0.05)
Treatment	0.04	0.02
Storage	0.03	0.01
Treatment × Storage	0.09	0.04

Table 5: Effect of treatment and storage on sodium and potassium content (mg/100g) of flaxseed flour blended crackers

Treatment	Sodium (mg/100g)					Potassium (mg/100g)				
	Storage Period (days)					Storage Period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
S_1 (100:00 :: RWF :PDRFF)	524.72	520.85	516.23	514.03	518.95	98.59	95.20	93.43	91.15	94.59
S_2 (95 :05 :: RWF :PDRFF)	526.08	522.63	518.36	515.93	520.75	143.68	139.72	136.73	132.73	138.25
S_3 (90 :10 :: RWF :PDRFF)	527.99	524.39	521.01	517.69	522.77	191.34	187.04	183.28	181.56	185.80
S_4 (85 :15 :: RWF :PDRFF)	529.86	525.96	522.98	519.08	524.47	249.16	243.82	239.82	237.41	242.55
S_5 (80 :20 :: RWF :PDRFF)	531.47	527.56	524.24	521.78	526.26	310.03	304.63	299.18	295.18	302.18
S_6 (75 :25 :: RWF :PDRFF)	532.91	529.98	526.53	524.56	528.49	365.36	359.51	353.37	347.96	356.55
S_7 (70 :30 :: RWF:PDRFF)	534.20	531.10	527.99	525.01	529.57	408.10	402.68	396.45	389.32	399.13
Mean	529.60	526.06	522.47	519.72		252.32	247.51	243.18	239.33	

Effect	C.D. (P=0.05)	C.D. (P=0.05)
Treatment	0.04	0.04
Storage	0.03	0.03
Treatment × Storage	0.09	0.08

increased with the incorporation of partially defatted roasted flaxseed flour. Among the various treatments, S_7 (30% flaxseed flour) recorded the highest iron content of 7.96 (mg/100g) at 0 day storage. However, after 90 days of storage, the lowest iron content of 6.07 (mg/100g) was recorded by treatment S_1 (0% flaxseed flour). There was a significant decrease in the iron content of crackers as the storage period advanced. The mineral content were found to decrease with storage. Similar results have been reported by Mosha *et al*. (2010) in cassava based composite crackers.

Sodium

The results regarding sodium content of different treatment are presented in Table 5. It is evident from the results that sodium content of all the treatment increased significantly with the increase in the level of partially defatted roasted flaxseed

flour incorporation. At 0 day, the increase in level of partially defatted roasted flaxseed flour supplementation in refined wheat flour improved the sodium contents, from 524.72 mg per 100 g (0% flaxseed flour) to 534.20 mg per 100 g (30% flaxseed flour). After 90 days of storage, the highest sodium content of 525.01 mg per 100 g was recorded in S_7 (30% flaxseed flour) whereas, the lowest of 514.03 mg per 100 g was recorded in S_1 (0% flaxseed flour). The mean value of sodium content decreased from 529.60 mg per 100 g at 0 day of storage to 519.72 mg per 100 g after 90 days of storage. The mineral contents were found to decrease with storage. Similar results have been reported by Mosha *et al*. (2010) in cassava based composite crackers.

Potassium

A perusal of data (Table 5) indicated that the treatments significantly influenced potassium content of crackers. At 0 day of storage, treatment S_7 (30% flaxseed flour) recorded the highest potassium content of 408.10 mg per 100 g whereas, the lowest value of 98.59 mg per 100 g was observed in treatment S_1 (0% flaxseed flour). However, after 90 days of storage, treatment S_1 (0% flaxseed flour) recorded the lowest value of 91.15 mg per 100 g% and highest value of 389.32 mg per 100 g was observed in S_7 (30% flaxseed flour). Storage period also significantly influenced potassium content of crackers. There was a significant decrease in the potassium content from 0 day to 90 days of storage. The mineral content decreased with storage. Similar results have been reported by Mosha *et al*. (2010) in cassava based composite crackers.

CONCLUSION

A novel cracker product incorporated with flaxseed was successfully developed. As the level of roasted and defatted flaxseed flour increased from 0-30%, antioxidant activity, total phenols, calcium, potassium and iron increased. The crackers exhibited a storability of 90 days at ambient conditions without adversely affecting the quality characteristics. Thus, the use of flaxseed supplemented crackers can be helpful for consumers having issues with their cardiovascular health.

REFERENCES

AACC. 1990. Approved methods of American Association of Cereal Chemistry, pp. 142-153. Saint Paul, Minnesotea, U.S.A.

Amarowicz, R., Pegg, R.B., Rahimi-Moghaddam, P., Barl, B. and Weil, J.A. 2004. Free radical scavenging capacity and antioxidant activity of selected plant species from the Canadian prairies, *Food Chem.,* **84**(4): 551-562.

AOAC. 2005. Official methods of analysis. 17th edition Association of Official Analytical Chemists, Washington, D. C.

Betsy, N. 2011. Fiber content and storage stability of antioxidant activity of nutraceutical mango products and gluten-free cookies. In: Second International Conference on Biotechnology and Food Science, **7** IACSIT Press, Singapore.

Chita, U. 1994. Effect of storage and processing on phytic acid levels in legumes and its interference with the utilization of protein and iron. Ph.D. thesis. Andhra Pradesh Agriculture University, Hyderabad, India.

Daun, J.K. and Przybyeiski, R. 2000. Environmental effects on the chemical composition of four Canadian flax cultivars. *Processing of Flax Inst.,* **58**: 80-91.

Kaur, R. 2011. Baking and sensory quality of whole wheat and flaxseed based cookies and muffin. M. Sc. thesis. Punjab Agricultural University, Ludhiana, India.

Koga, K., Taguchi, A., Koshimizu, S., Sunia, Y., Yanadad, Y., Shirasaka, N. and Yoshizum, H. 2007. Reactive oxygen scavenging activity of matured whiskey and its active polyphenols. *J Food Science*, **72**: 212-217.

Kohajdova. Z., Karovicova. J. and Magala. M. 2013. Rheological and qualitative characteristics of pea flour incorporated cracker biscuits. *J Food Sci Technol.,* **5**(1): 11-17.

Mosha, T.C.E., Sadick, M.A. and Laswai, H.S. 2010. Development and evaluation of organoleptic quality and acceptability of cassava-based composite crackers for supplementing primary school children. *Tanzania J Agri Sci.,* **10**(1): 8-21.

Oomah, B.D. 2001. Flaxseed as a functional food source. *J Sci Food Agri.,* **81**: 889-894.

Payne, T.J. 2000. Promoting better health with flaxseed in bread. *Cereal Foods World,* **45**: 102–104.

Sadasivam, S. and Manickam, A. 2008. Antinutritional factors (eds.). *Biochemical Methods*, pp. 215-216. New Age International Publisher, New Delhi.

Salunkhe, D.K., Chavan, J.K. and Kadam, S.S. 1990. *Dietary tannins: consequences and remedies.* pp 49-50. CRC press, Inc. United States.

Sedej, I., Sakac, M., Mandic, A., Misan, A., Pestoric, M., Simurina, O. and Brunet, J.C. 2011. Quality assessment of gluten-free crackers based on buckwheat flour. *Food Sci Technol.*, **44**: 694-699.

Siro, I., Kapolna, E., Kapolna, B. and Lugasi, A. 2008. Functional food. Product development, marketing and consumer acceptance – A review. *Appetite.*, **51**: 456-467.