PRINT: ISSN 0973-7189 ONLINE: ISSN 2456-6780
Stud Home Com Sci, 9(2,3): 61-64 (2015)
DOI: 10.31901/24566780.2015/09.2-3.01

Nutrient Analysis of Germinated Sesame Seeds and Development of Value Added Biscuits

Roomani Jain[1] and Ila Joshi[2]

[1,2]Department of Home Science, the IIS University, Jaipur 302 020, Rajasthan, India
E-mail: roomani.jain@gmail.com

KEYWORDS Analysis. Antinutrients. Nutrients. Germination. Sesame

ABSTRACT India is one of the largest producers and exporters of sesame seeds. Sesame is an oilseed with high nutritional quality. With a rich, nutty flavor, it is a common ingredient in cuisines across the world. When germinated, its nutritional quality is enhanced and can be used in various commonly consumed foods prepared at the household level. In the present study, an effort was made to analyze nutrient and antinutrient contents of germinated (48 hours) sesame seeds and develop biscuits using its powder in different proportions (5g, 10g, 15g, 20g, 25g and 30g). The sensory evaluation of the developed biscuits showed highest acceptability for those with 15g germinated sesame seed powder. Its nutritive value and shelf life were found to be good.

INTRODUCTION

Sesame is an ancient and long season crop. Its seeds have been widely used among many cuisines around the world (Mohamed et al. 2007). Sesame seeds contain high quality protein. It is one of the most concentrated calcium sources and contains iron, which plays a great role in the body as well as, zinc, a mineral involved in the metabolism of carbohydrates, fats and proteins. Hence, it is beneficial for the people of all the age groups (Gopalan et al. 1989). Sesame seeds are rich in sesamin, a phytoestrogen (Adlecreutz 2007), which is important in prevention of osteoporosis (Mansour et al. 2015), menopausal symptoms, cancer and heart disease (Nakai et al. 2003). Natural forms of vitamin E, such as those found in sesame seeds, are having anti-aging properties (Yamashita et al. 1992). Sprouts of sesame seeds make a nutritious addition to many food recipes like, salads, sandwiches, stir-fry, desserts, soufflés and cookies. After germination the fat content of sesame seeds reduces, while linolenic acid, sodium, potassium and calcium content increases and antinutrient content like oxalate and phytate reduces (Hahm et al. 2008). Germinated sesame seeds can be incorporated in various dishes prepared at home or commercially.

Objective

To analyze nutrient and antinutrient content of germinated sesame seeds and to develop value added biscuits by incorporating germinated sesame seed powder.

METHODOLOGY

Sesame seeds of the *desi dellelo* variety were procured in bulk from the farm to avoid varietal differences. These seeds were cleaned and washed thoroughly, dried and then stored in airtight containers. For germination, the seeds were first soaked in water for 12 hours, and then kept for germination in a sprout maker for 48 hours at room temperature. The study was conducted in 2 phases. The first included the analysis of nutrients and antinutrients present in germinated sesame seeds and secondly, the development of value added biscuits. In the first phase, the samples of germinated sesame seeds were analyzed for their proximate composition, for which standard techniques (Raghurmulu et al. 2003) and analytical grade chemicals were used. The moisture content was determined by drying the seeds in an oven at 100-105°C, till constant weight was obtained. Crude protein was calculated from nitrogen content, which was estimated using the micro-kjeldahl method. Fat was estimated using the ether-extractive method and Soxhlet apparatus. Ash was determined by incinerating the sample at 600°C in a muffle furnace. The method used for estimating crude fiber was the acid alkali method. Total carbohydrate was determined by subtracting a sum of crude protein + crude fat + ash + crude fiber + moisture content from 100.

Among micronutrients, iron was determined using Wong's method (Raghurmulu et al. 2003), making use of the fact that ferric iron gives a blood red color with potassium thiocyanate. Titration method was used to estimate calcium

content (Raghurmulu et al. 2003) and phosphorus content was estimated using a colorimetric method (Raghurmulu et al. 2003). Vitamin C was also estimated colorimetrically (Raghurmulu et al. 2003).

The anti-nutrients oxalates and phytates, were estimated using standard techniques (Kawatra 2004). The oxalic acid was extracted in HCL and precipitated as calcium oxalate by adding calcium chloride, which was then washed and titrated with N/20 $KMnO_4$ in the presence of dilute sulphuric acid at 70°C. The phytic acid was extracted in 0.5 M nitric acid and treated with ferric ammonium sulphate and isoamyl alcohol.

Second phase of the study included development of value added biscuits. The ingredients used are given in Table 1. The procedure for making biscuits included sifting of wheat flour, gram flour and baking soda together in a pan to which cardamom powder was added. These ingredients were then mixed properly. In another pan, melted *ghee* (clarified butter) was beaten with sugar till the mixture became light. This was then added to sifted dry mix. Milk was used to prepare the dough, which was then rolled out into a half-inch thick sheet. With the help of a biscuit cutter the biscuits were cut out in the desired shape. These were then baked in a preheated oven for 15 minutes. Sensory evaluation of the biscuits was carried out using a 5-point rating scale till the recipe was finally standardized. These were then considered as control. To the standardized biscuits, powder of germinated sesame seeds was added in different proportions (Table 2) (5g 10g, 15g, 20g, 25g and 30g) and was evaluated for sensory attributes, like appearance, color, taste, aftertaste and overall acceptability by a team of 10 semi-trained panel members. Shelf life of the biscuits, with most acceptable proportion of sesame seeds, was estimated using microbiological analysis and organoleptic methods over a period of two months and the cost and nutritive value were also calculated.

Table 1: Ingredients used in standard wheat flour biscuits

Ingredients	*Amount*
Whole wheat flour (g)	80
Gram flour (g)	40
Baking soda (g)	2
Sugar (g)	40
Ghee (g)	40
Cardamom powder (g)	2
Milk (ml)	10

Table 2: Proportion used for development of wheat flour sesame biscuits

Coding	*Proportion*
A	Whole wheat flour (80g)- Standard
B	Whole wheat flour (75g) + Sesame seeds powder (5g)
C	Whole wheat flour (70g) + Sesame seeds powder (10g)
D	Whole wheat flour (65g) + Sesame seeds powder (15g)
E	Whole wheat flour (60g) + Sesame seeds powder (20g)
F	Whole wheat flour (55g) + Sesame seeds powder (25g)
G	Whole wheat flour (50g) + Sesame seeds powder (30g)

RESULTS AND DISCUSSION

The nutrient estimation of the germinated sesame seeds revealed seeds to be a rich source of protein (22.97±0.04g/100g), fat (37.08±0.81g/100g) and calories (509.6±5.66kcals/100g). Dhadhwal and Joshi (2013) in their study have reported protein content of germinated sesame seeds (24 hours) to be slightly less than that estimated in the present study, that is 20.79± 0.05g/100g and fat content to be higher by around 7g/100g, the same being 44.01±0.12g/100g. The micronutrient content of the germinated sesame seeds also revealed seeds to be rich in calcium (1257.74±0.30 mg/100g) and iron (7.83±0.04mg/100g) (Table 3). According to Dhadhwal and Joshi (2013), the calcium content

Table 3: Mean nutrient and anti nutrient content of sesame seeds, germinated for 48 hours

Nutrients	*Germinated sesame seeds*
Macronutrients	
Moisture(g/100g)	9.37 ± 0.21
Ash (g/100g)	5.67 ± 0.24
Protein (g/100g)	22.97 ± 0.04
Fat (g/100g)	37.08 ± 0.81
Fibre (g/100g)	3.18 ± 0.11
Carbohydrate (g/100g)	23.98 ± 0.46
Energy (kcals/100g)	509.6 ± 5.66
Micronutrients	
Calcium (mg/100g)	1257.74 ± 0.30
Iron (mg/100g)	7.83 ± 0.04
Phosphorus(mg/100g)	484.86 ± 1.55
Vitamin C (mg/100g)	2.38 ± 0.07
Anti- nutrients	
Oxalate (mg/100g)	1.33 ± 0.01
Phytate (mg/100g)	1.003 ± 0.28

± Standard deviation

of 24-hour germinated sesame seeds was also found to be less by 100 mg/100g (1157.52±0.41 mg/100g) and that of iron to be slightly less by around 1mg/100g (6.97±0.03 mg/ 100g) when compared with nutrient content of non-germinated seeds.

The formulated wheat flour sesame biscuits were liked by panel members (Table 4). Almost all the sensory attributes of developed biscuits, having 5g, 10g and 15g of germinated sesame seed powder, scored more in comparison to standard biscuits. The biscuits with 15g of germinated sesame seed powder revealed highest overall mean scores (4.72±0.08).

The shelf life assessment of these biscuits revealed acceptability to be good till 15th day, thereafter the acceptability reduced gradually (Table 5). Analysis of peroxide value revealed negligible rancidity even after 60 days of storage. Microbial analysis too showed the number of colonies to be negligible (6.27×10^{-1} on day one, 6.80×10^{-1} on day 15 and 9.50×10^{-1} on day 60) even after storage for 60 days, making biscuits safe for consumption. Shabbir et al. (2015) also found out that germinated sesame seeds have high antioxidant properties due to the increase in phenolic content during germination which helps in enhancing shelf life of products to which germinated sesame seeds are added.

The nutrient content of one portion of developed biscuits that is, 40g (4 biscuits), was

Table 4: Mean sensory scores of the biscuits having 15 g of germinated sesame seeds powder*

Code	*Appearance*	*Colour*	*Taste*	*After taste*	*Overall acceptability*	*Overall mean scores*
A	4.1 ±0.87	4.2±0.63	4 ±0.66	4 ±0.47	4.1±0.31	4.08±0.08
B	4.2 ±0.78	4.3±0.48	4 ±0.47	4.1±0.56	4.2±0.63	4.16±0.11
C	4.5 ±0.52	4.4±0.51	4.2±0.42	4.5±0.52	4.4±0.51	4.4 ±0.12
D	4.8 ±0.42	4.8±0.42	4.7±0.48	4.6±0.51	4.7±0.48	4.72±0.08
E	3.8 ±0.78	3.7±0.67	3.7±0.48	3.6±0.69	3.7±0.48	3.7 ±0.07
F	3.7 ±0.67	3.4±0.51	3.3±0.48	3.4±0.51	3.5±0.52	3.46±0.15
G	3.4 ±0.96	3.3±0.38	3.2±0.42	3.3±0.48	3.3±0.48	3.3 ±0.07

± Standard deviation
*5 was extremely desirable and 1 was extremely undesirable

Table 5: Changes in organoleptic characteristics of stored wheat flour sesame biscuits having 15 per cent germinated sesame seeds powder

Days	*Appearance*	*Colour*	*Taste*	*After taste*	*Overall acceptability*
15 day	4.0±0.42	4.0±0	4.3±0.42	4.0±0.42	4.1±0.31
30 day	3.8±0.47	4.0±0.47	4.2±0.67	3.8±0.47	4.0±0.47
45 day	3.7±0.48	3.8±0.42	3.7±0.48	3.5±0.52	3.6±0.51
60 day	3.6±0.51	3.7±0.48	3.5±0.52	2.7±0.48	3.2±0.42

± Standard deviation

Table 6: Nutritive value of developed wheat flour sesame biscuits

Ingredients	*Amt (g)*	*Protein (g)*	*Fat (g)*	*Fibre (g)*	*Carbohydrates(g)*	*Calcium (mg)*	*Iron (mg)*	*Vit. C (mg)*
Wheat flour	65	7.8	1.1	12.35	45.11	31.2	31.8	Nil
Germinated sesame seeds	15	3.44	5.56	0.47	3.59	188.56	1.17	0.35
Gram flour	40	8.32	2.24	0.68	23.92	22.4	2.12	Nil
Sugar	40	0.04	-	-	39.76	4.8	0.06	-
Ghee	40	-	40	-	-	-	-	-
Milk	10	0.32	0.41	-	1.76	12	0.03	0.2
Cardamom powder	2	-	-	-	-	-	-	-
Baking soda	2	-	-	-	-	-	-	-
Total	214	19.92	49.31	13.5	114.14	258.96	35.18	0.55
Portion size (40g)		3.72	9.2	2.5	21.33	48.40	6.57	0.10

calculated and it was found that one serving of biscuits provided about 4g of protein, 9g of fat, 3g of fiber, 21g of carbohydrate, 48 mg of calcium, 7 mg of iron and 0.10 mg of vitamin C (Table 6).

The cost of one portion of sesame biscuits, calculated using market rate existed at the time of its development, was found to be INR 5 (Table 7).

Table 7: Cost of developed wheat flour sesame biscuits

Ingredients	*Amt (g)*	*Cost /kg (Rs)*	*Cost / amount (Rs)*
Wheat flour	65	24	1.92
Germinated sesame seeds	15	90	1.35
Gram flour	40	50	2
Sugar	40	36	1.44
Ghee	40	400	16
Milk	10	32	0.32
Cardamom powder	2	1100	2.2
Baking soda	2	160	0.32
Total	214		25.55
Cost per Portion (40g)		5.00	

CONCLUSION

Germination process improved the nutritional quality of sesame seeds. Biscuits with a proportion of fifteen percent sesame seed powder showed highest acceptability. These value added biscuits are easy to prepare at the household level, at a very low cost.

RECOMMENDATIONS

Consumption of germinated sesame seeds can be helpful in combating protein energy malnutrition and other micronutrient deficiency diseases in children, as these are rich source of energy, protein, iron and calcium. Food items made by incorporating sesame seeds can also be included in dishes prepared under the Midday Meal Scheme for school children. Value added products made from sesame seeds can also be beneficial for pregnant ladies, lactating mothers, post menopausal women and adolescent girls.

ACKNOWLEDGEMENTS

The researchers acknowledge the facilities provided by the IIS University for conduction of research. The participation and cooperation of the 10 panel members are also thankfully remembered for accomplishing the task.

APPENDIX

Desi- local, indigenous
Desi dellelo – a variety of sesame seeds

REFERENCES

Adlercrutz H 2007. Lignans and human health. *Critical Reviews in Clinical Laboratory Sciences*, 44: 483-525.

Dhadhwal B, Joshi I 2013. *Nutritional Analysis of Raw and Processed Sesame Seeds and Development of Value Added Product*. Dissertation Thesis, Unpublished. Rajasthan: The IIS University, Jaipur.

Gopalan C, Rama Sastri BV, Balasubramanian SC, Swaminathan SC, Rao Narsinga BS et al. 1989. *Nutritive Value of Indian Foods*. Hyderabad: National Institute of Nutrition.

Hahm TS, Park SJ, Martin Lo Y 2008. Effects of germination on chemical composition and functional properties of sesame (Sesamumindicum L.) seeds. *Bioresour Technol*, 100(4): 1643-1647.

Kawatra A, Sehgal S, Singh U 2004. *Practical Manual of Food Analysis*. Hisar: Department of Food and Nutrition, Haryana Agriculture University.

Mansour F, Elhabeby M, Nooh H, El- Mehi A Refaey A 2015. The possible protective role of sesame on experimentally induced osteoporosis. *Journal of American Science*, 11(3s): 14-20.

Mohamed E, Souhail B, Olivier R, Christophe B 2007. Quality characteristics of sesame seeds and by-products. *Food Chemistry*, 103(2): 641–650.

Nakai M, Harada M, Nakahara K 2003. Novel antioxidative metabolites in rat liver with ingested sesamin. *J Agric Food Chem*, 51(6): 1666-1670.

Shabbir M, Iftikhar F, Khan M, Murtaza M, Saeed M, Mahmood M, Siraj N 2015.Effect of sesame sprouts powder on the quality and oxidative stability of mayonnaise. *Journal of Food and Nutrition Research*, 3(3): 138-145.

Raghurmalu N, Madhavan K, Kalyansundaram S 1986. *A Manual of Laboratory Techniques*. Hyderabad: National Institute of Nutrition.

Yamashita K, Nohara Y, Katayama K, Namiki M 1992. Sesame seed lignans and gamma-tocopherol act synergistically to produce vitamin E activity in rats. *J Nutr*, 122(12): 2440-2446.