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Meenakshi V
Assistant Professor, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India

K Kalaiselvan
Student, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India

M Ilamaran
Assistant Professor, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India

R Vijayalakshmi
Associate Professor, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India

Corresponding Author
Meenakshi V
Assistant Professor, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India

Formulation of functional gingelly spread

Meenakshi V, K Kalaiselvan, M Ilamaran and R Vijayalakshmi

Abstract
The major Gingelly producers are India, Myanmar, China and Sudan with 68% of the total world production. Value addition by developing a product like Gingelly spread makes the nutritional benefits more available and easy to consume for all age groups in different food preparations. Gingelly spread is categorized among nutraceutical and functional foods and healthy alternative product which can be eaten as spread on bread, biscuit sandwiches, salad dressing and in soups. In the present study Gingelly spread was developed by subjecting to two pretreatments such as roasting for 5 minutes with 30 per cent and baking for 180 ºC for 30 minutes. From Sensory scores it was found that Gingelly seeds roasted for five minutes and Gingelly seeds baked at 180 ºC for 30 minutes added with other standardized ingredients secured higher organoleptic scores. The composition of gingelly spread was 100 g of gingelly seeds (roasted / baked), 30 gm of Sugar, 0.5 gm of salt, five ml gingelly oil and one per cent stabiliser. The products were packed in PET boxes and stored at room temperature. The quality parameters such as moisture, ash, protein, fat, fiber, free fatty acid value, phytic acid, oxalic acid, colour value and Microbial load were analyzed. The developed product could be stored upto 30 days without any preservative.

Keywords: spread, organoleptic score, stabiliser

Introduction
Gingelly seed is acting as a microcapsule with numerous bioactive components showing medical importance. It is also knowen as gingelly, til, benne seed and popularly as "Queen of Oilseeds" due to its high degree of resistance to oxidation and rancidity. Gingelly seeds contain 50-60 per cent oil, 18-25 per cent protein, 13.5 per cent carbohydrate and five per cent ash. Gingelly seed is rich in polyunsaturated fatty acids (PUFA) and natural antioxidants, sesamin, sesamolin and tocopherol, health promoting phytochemicals such as phytosterols, phytates and other phenolics. These bioactive components enhance the stability and keeping quality of Gingelly oil along with numerous health benefits. Recent studies on the antioxidant and anti-carcinogenic activities of Gingelly seed have greatly increased its applications in health food products that assert for liver and heart protection and tumor prevention. In addition to these important nutrients, Gingelly seeds contain two unique substances, sesamin and sesamolin. Both of these substances belong to a group of special beneficial fibers called lignans and have a cholesterol lowering effect in humans and prevent high blood pressure and increase vitamin E supplies in animals.
Gingelly seeds are used for the production of oil, paste, salads and in various food formulations. Value addition by developing a product like Gingelly spread makes the nutritional benefits more available and easy to consume for all age groups in different food preparations. Gingelly spread is categorized among nutraceutical and functional foods and healthy alternative product which can be eaten as spread on bread, biscuit sandwiches, salad dressing and in soups. Hence the present study is carried out to develop and evaluate nutritionally rich gingelly spread.

Materials and Methods
Gingelly Spread was prepared by using roasted white Gingelly seeds (roasting 5min)/ baked seeds (180 °C for 30 min), Sugar 30%, Salt 0.5%, Gingelly oil 5% and 1% lecithin. The moisture, protein, fat, fibre, minerals, phytic acid and acid value of the product was analysed as per the procedure prescribed by AOAC, 1980. Colour value of the product was done using Hunter colour meter. Organoleptic evaluation of gingelly spread for various quality attributes such as color, texture, flavor, taste and overall acceptability, was done by a panel of 30 semi trained panel members using nine point hedonic scale as per the procedure given by Watts *et al.* (1989) [12].

Formulation of Gingelly spread

Commercially available white Gingelly was purchased from local market. Then the seed subjected for different pretreatments such as Roasting for 5 min at medium flame and Baking for 180 ºC for 30 min in baking oven. Gingelly spread were prepared by by using pretreated gingelly seeds with sugar 30% and 40%, Salt 0.5%, Gingelly oil 5%, stabilizer Lecithin (0.5% and 1.0%). Then grinded by electronic mixer during grinding 0.5% and 1.0% Lecithin is added. Grinded spread was filled in pasteurized PET boxes.

Table 1: composition of Gingelly spread

Gingelly spread	
Baking (180 º C for 30 min)	Roasting (5 minutes)
Gingelly – 100 g	Gingelly – 100 g
Sugar – 30 g	Sugar – 30 g
Salt – 0.5 g	Salt -0.5 g
Oil – 5 ml	Oil – 5 ml
Stabilizer – 0.5 & 1%	Stabilizer – 0.5 & 1%

Flow chart for the preparation of Gingelly Spread

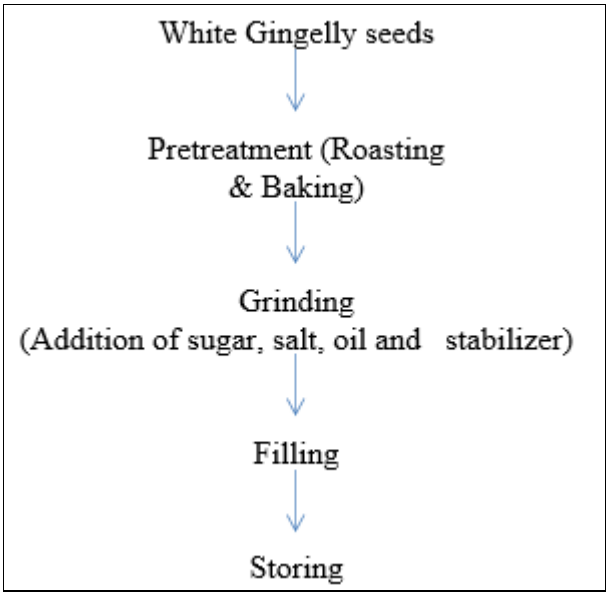

Table 2: Sensory characteristics of Gingelly spread

Gingelly spread		
Sensory characteristics	**Roasted seeds**	**Baked seeds (180 º C for 30 min)**
Appearance	7.9	7.9
Color	7.9	7.6
Flavour	7.8	7.8
Texture	7.8	8.0
Taste	7.8	8.0
Overall acceptability	7.8	8.0

The prepared products were evaluated organoleptically for various quality attributes such as color, texture, flavor, taste and overall acceptability, by a panel of 15 trained and untrained judges using 9 point hedonic scale as per the procedure given by Watts *et al.* (1989) [12]. Roasting is the main thermal processing technique used for nuts and oil seeds in order to enhance their sensory properties and value addition. The overall acceptability of Gingelly spread developed using baked seeds was 8.0 and roasted seeds was 7.8.

Microbial Analysis

The total plate count, yeast and mold count were enumerated in gingelly spread during storage. Total plate count: Gingelly spread sample of 1 g was diluted in 100 ml of 0.1% peptone water. Then serially diluted and spread plated on plate count agar. The plates were incubated at 37 ºC for 48 hours and the colonies were counted and expressed as CFUg $^{-1}$ of the sample. Yeast and mould count: Gingelly spread sample of 1 g was diluted in 100 ml of 0.1% peptone water. Then serially diluted and spread plated potato dextrose agar. The plates were incubated at 25 ºC for 3 to 5 days and the colonies were counted and expressed as CFUg $^{-1}$ of the sample.

Results and Discussion

Table 3: Nutritional characteristics of Gingelly seeds

Parameters	Gingelly seeds
Moisture (g%)	2.57
Ash (g%)	5.553
Protein (g%)	24.06
Fat (g%)	42.33
Fibre (g%)	12.57
Phytic acid (mg/100g)	6.8761
Oxalic acid (mg%)	1.3
Phosphorus (mg/100g)	508
Calcium (mg/100g)	316

The white Gingelly seeds had a moisture content of 2.57% and it is a rich source of fat (42.33%), protein (24.06%) and fibre (12.57%). The seed is rich in protein and the protein has disable amino acid profile with good nutritional value similar to soybean (NAERLS, 2010) [10].

The chemical composition of Gingelly shows that the seed is an important source of oil (44-58%), protein (18-25%), carbohydrate (~13.5%) and ash (~5%) (Borchani *et al*., (2010) [2]. Gingelly seed is approximately 50 percent oil (out of which 35% is monounsaturated fatty acids and 44% polyunsaturated fatty acids) and 45 percent meal (out of which 20% is protein) (Ghandi, 2009; Hansen, 2011) [5, 7]. Compositional differences can exist among the different varieties of sesame seeds, among different agroclimatic conditions

The phytic acid and oxalic acid content of dehulled gingelly seed was 6.8761 and 1.3 mg% respectively. Anti-nutritional factors form complexes with nutrients and hence block micronutrients to be absorbed by body cells. Oil seeds contain significant amount of phytic acid, fibers and other binding agents that can reduce bioavailability of minerals obtained from the seeds. Hence reducing the antinutritional factors is essential for the development of gingelly spread.

The moisture (wb), crude protein, ash, fat, fiber, total carbohydrate, Ca, Zn and Fe (db) were ranged: 3.17% - 3.96%, 22.58% - 24.27%, 4.46% - 6.19%, 50.88% - 52.67%, 5.60% - 6.26%, 8.3% - 11.69%, 1172.08 - 1225.71 mg/100g, 4.23 - 4.45 mg/100g and 10.2 - 10.75 mg/100g, respectively (Haftom Zebib *et al.*, 2015) [6].

Table 4: Changes in Physico- chemical and Nutritional Characteristics of developed products during storage

Parameters	Storage days	Gingelly spread	
		Baked seeds	Roasted seeds
Moisture (g%)	Initial	0.701	0.36
	30 days	0.708	0.35
Acid value (mg KOH /g)	Initial	0.66	0.681
	30 days	1.066	1.04
Ash (g%)	Initial	4.012	4.4
	30 days	4.0	4.4
Calcium(mg%)	Initial	300.2	300
	30 days	300.2	300
Phosphorus (mg%)	Initial	500.4	500.8
	30 days	500.4	500.8
Colour value			
L value	Initial day	251.7	242.19
a value		1.8	3.4
b value		27.06	17.76

The acid value of gingelly spread was 0.66 mg KoH/g and it was increased to 1.04 mg KoH/g after 30 days of storage. The increase in acid value might be due to free fatty acid formation during storage. This increase of acidity could be explained by hydrolysis of triglycerides to free fatty acids. The increase in acid value was below the FSSAI specification of 4.0mg KOH/g.

High level of ash makes the oilseed a good source of mineral nutrition to the consumer**.** Ash content which is an index of total mineral matter present in the seeds. There was no changes in ash content during storage. Gingelly spread developed using roasted gingelly seeds had higher ash content (4.4 g%) than gingelly spread from baked seeds (4.0 g%). Sesame is a good source for the minerals such as phosphorus and calcium. During pretreatments there is no changes in the minerals quantity. Initially sesame seed contains 508 mg/100g of Phosphorous and 300 mg/100g of Calcium. Developed product also remains same amount of minerals during storage. As per FSSAI specification peanut butter should contain not more than 3.0 g% of moisture, not less than 25.0 per cent by weight (on dry basis) of protein, Not less than 40 0 per cent by weight (on dry basis), Not more than 5.0 per cent by weight (on dry basis) of ash and salt as NaCl not more than 2% by weight.

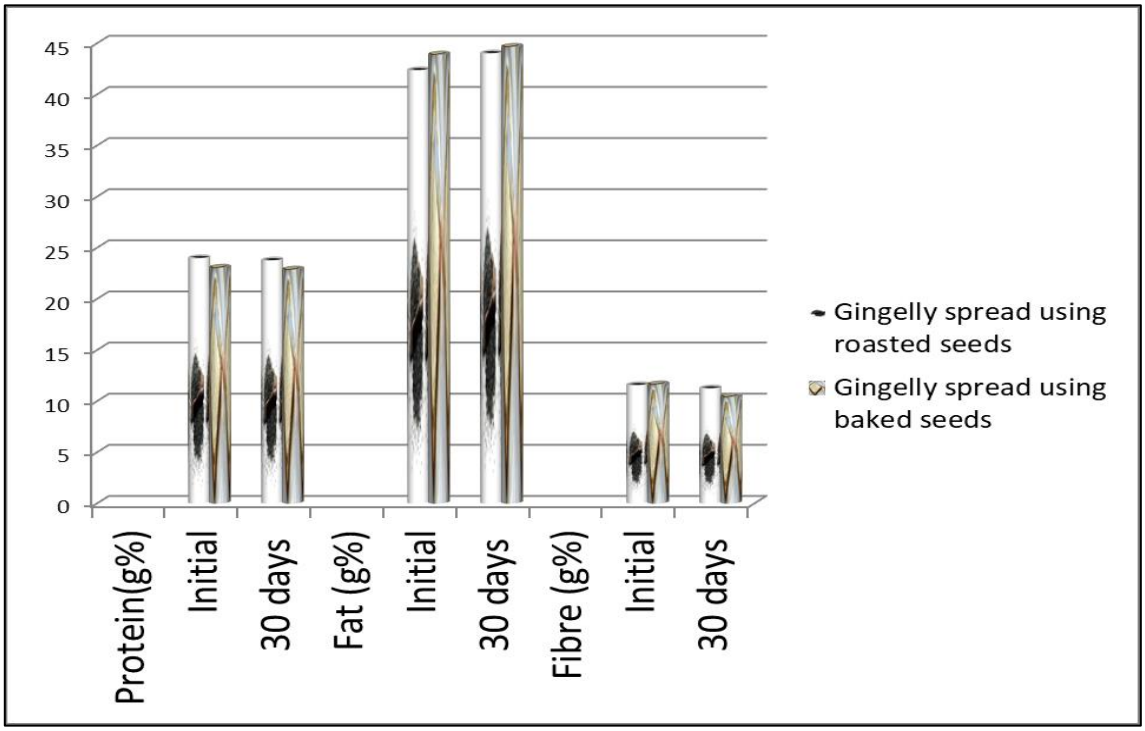

Fig 1: Changes in Protein, fat and fiber content of the stored gingelly spread

The roasted gingelly spread had a protein content of 23.98 g% which is slightly higher than baked seeds (22.04g%). Fat content of gingelly spread ranged from 42.36 – 43 g% and after 30 days of storage slight increase in fat content was observed to 44 g%. The developed spread was rich in fibre (11 g%). There was no significant changes observed in fat and protein content of gingelly spread during storage of 30 days.

Makinde, F.M. and Akinoso, R.2013 [9] reported that dehulled sesame cultivars had protein (25.3-26.8%), fat (47.7- 49.9%) and carbohydrates (9.7-12.4%). The hulls however contain lowest amount of protein, fat and carbohydrate. Calcium was highest (473.6–521.9 mg/100 g) followed by phosphorus (466.0–482.8 mg/100 g) and potassium (465.7–468.8 mg/100 g) in whole seeds compared with lower values observed for dehulled seeds and hulls.

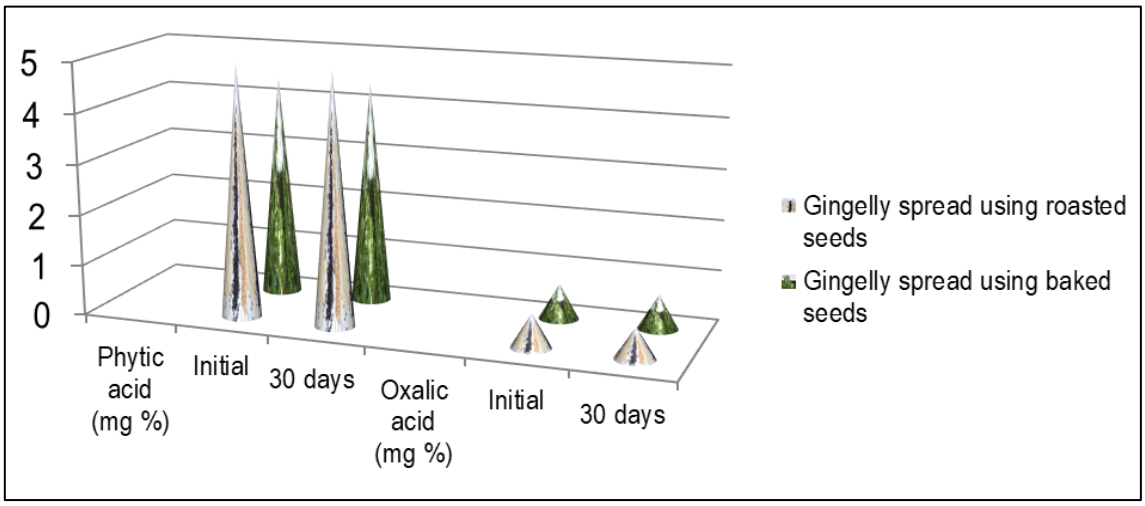

Fig 2: Changes in anti-nutritional factors of gingelly spread

Phytic acid contents of the sesame varieties were affected by genotypes and it depends on the size of the seeds In the present study phytic acid content in gingelly spread developed by baked seed was 4.4 mg% and in roasted sample it was 4. 9 mg%. No changes in phytic acid content was observed during storage. Higher the moisture content, the higher the phytate loss. In the present study the moisture content of the gingelly spread from roasting process is 0.3 g% and in baked seed is 0.70 g%. The reduction in the phytate content as a result of roasting may be due to insoluble phytins formed between phytic acid and some minerals. Processing treatment were observed to decrease the phytate and oxalate contents significantly (p<0.05) in both whole and dehulled cultivars with a maximum reduction observed after germination (Makinde, F.M. and Akinoso, R.2013) [9].

The apparent decrease in phytate content during thermal processing may be partly due either to the formation of insoluble complexes between phytate and other components, such as phytateprotein and phytate-protein-mineral complexes or to the inositol hexaphosphate hydrolyzed to penta- and tetraphosphate (Siddhuraju and Becker, 2001) [11].

The oxalic acid content of developed gingelly spread was 0.66 mg per cent which was 50 per cent lesser than the fresh gingelly seeds. It can be inferred that thermal treatments such as roasting and baking have positive impact in reducing the antinutritional content. The oxalic acid content of spread was not significantly changed during storage.

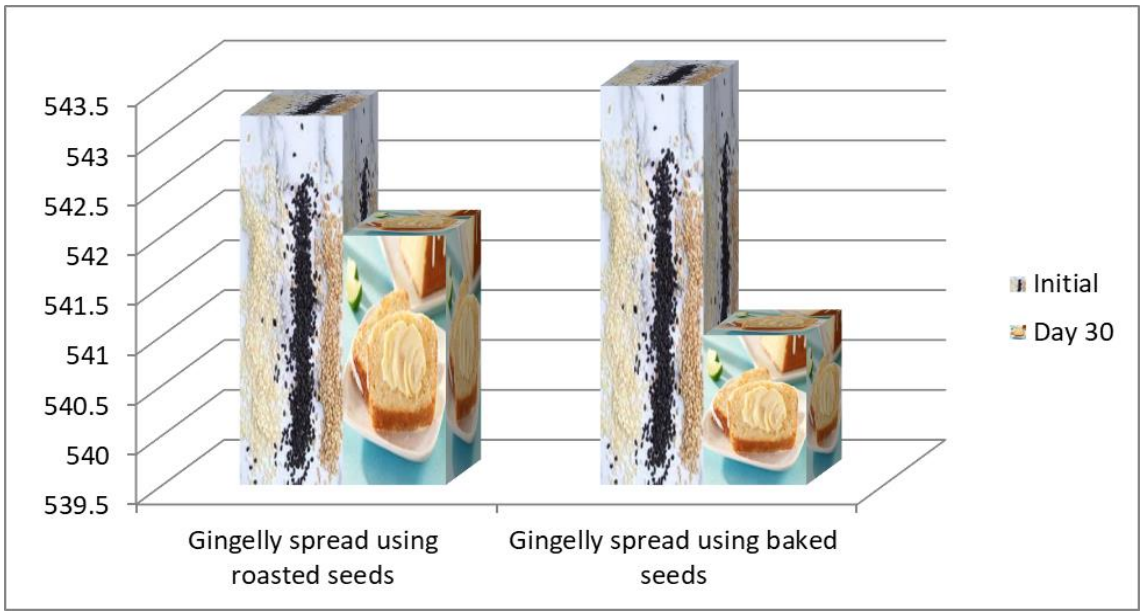

Fig 3: Changes in total antioxidant activity of the stored gingelly spread

The bioactive compounds and antioxidant activity of foods is affected by thermal treatments either in positive or negative mode. However, the total antioxidants capacity after roasting is the result of the thermal degradation of naturally occurring antioxidant compounds and the formation of new Maillard reaction products having antioxidant activity. In the present study the antioxidant activity of gingelly spread is 543 mg RE/100g and a slight reduction was observed during storage. Hence the white roasted sesame seed is suitable for further uses or for development as a health care product with antioxidant activity. Chandrasekara and Shahidi (2011) [3] suggested that roasting cashews at high temperature short time enhances effectively its antioxidant activity. An increase in bioactive compounds is believed to give the plausible taste in roasted and fried nuts rather than the raw one.

The antioxidant activity levels by FRAP and DPPHSA was increased on roasting in both ground nut and sesame seeds at 1% significant difference level except ground nut in DPPH

scavenging assay. (Kamalaja, 2018) [8]
The present study indicates that white sesame seeds, with high total contents of antioxidant and gingelly seed extracts were significantly affected by domestic roasting method. Improvement result might be partially attributed to the formation of Maillard reaction products. Therefore, the consumption of groundnut and sesame seed and its products offers.

Microbial characteristics of Gingelly spread during storage
The microbial population of the freshly prepared gingely spread had found in not detectable level. Total Plate Count was 6.36 $x10^4$ and Yeast and Mould $3.64x10^2$ in Roasting and Total Plate Count was $3.64x10^4$ and Yeast and Mould count was $2.72x10^2$ in Baking after one month of storage respectively.

Microbial characteristics of Gingelly spread during storage

Storage days	Gingelly spread developed using roasted gingelly seeds		Gingelly spread developed using baked gingelly seeds	
	Total plate count	Yeast &Mould	Total Plate Count	Yeast &Mould
Initial	NDL	NDL	NDL	NDL
30^{th} day	$6.36x10^4$	$3.64x10^2$	$3.64x10^4$	$2.72x10^2$

Conclusion
The gingelly spread prepared using baked gingelly seeds had lower moisture content compared to spread prepared roasted seeds. 29 -35% of reduction in phytic acid was noticed in gingelly spreads prepared using roasted and baked seeds when compared to fresh gingelly. The developed gingelly spread had a protein content of 22.04-23.76 g%, fat ranged from 42.36-44.05 g%, Fibre ranged from 11.33-11.63 g%. Processed sesame seed could serve as ingredients in food formulation to reduce malnutrition among vulnerable groups. Higher colour value was observed in gingelly spreads prepared using roasted seeds than baked seeds. The Increase in acid value of gingelly spread was below the FSSAI recommendations (Not more than 4.0). The nutritionally rich gingelly spread can be a good alternate choice for peanut allergeic persons and can also be recommended to children, adolescence, sports person and emergency ration.

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