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## Studies on nutritional quality of defatted linseed flour cookies

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### Abstract

The quality cookies were prepared from 75% wheat flour and 25% defatted linseed flour (CWLF<sub>25</sub>). The selected treatments were packed in LDPE and PP and stored at ambient ( $30 \pm 4^{\circ}\text{C}$ ) for 90 days to study their storage feasibility. Chemical composition of the fresh cookies prepared from 75% wheat and 25% defatted linseed flour (CWLF<sub>25</sub>) showed that moisture content was 4.15%, protein 15.08%, crude fat 28.91%, crude fiber 4.08%, carbohydrates 50.26%, calcium 109.17 mg/100 g, and iron 5.71 mg/100 g. The sensory evaluation of cookies was carried out regularly at an interval of one month for 3 month during storage. The results on overall acceptability score of cookies are influenced by storage. The results indicated that score for overall acceptability of cookies was decreased for control from 8.48 to 8.32 in LDPE and from 8.38 to 8.23 in PP as storage period get increased. For CWLF<sub>25</sub> treatment score decreased from 8.70 to 8.54 in LDPE and 8.60 to 8.42 in PP was observed for 90 days of storage. Storage study of cookies showed that the cookies prepared by incorporation of wheat and defatted linseed flour can be stored up to 3 month in LDPE with minimum losses in sensory, nutritional and textural characteristics than PP. There was no significant difference in protein, fat, crude fiber, calcium and iron content with advancement of storage period during 3 month. The cookies were found to be acceptable up to 3 month storage at ambient temperature. The total cost of production of cookies prepared from maida and defatted linseed flour (CWLF<sub>25</sub>) for 1 kg was Rs. 172.24/-.

**Keywords:** Defatted linseed flour, cookies, nutritional value, organoleptic properties

### Introduction

Oilseed crops generally are one of the foremost important crops within the planet. Their role in human diet and also in the industrial application cannot be under-estimated. Incorporation of oilseeds increases nutritional index of the bakery products with and without gluten and provides several health benefits. The bakery industries in India are one of the biggest contributors to the country's processed food industry. The main advantages of the bakery products are their availability for fortification with cereals, millets and other functional ingredients (Kadam and Prabhashankar, 2010) [12]. Baking industry is one among the most important organized processed food industries. The recognition of the bakery products is especially due to their ready-to-eat nature, convenience, low cost and availability in wide number of varieties of different tastes and textural profiles.

Linseed (*Linum usitatissimum* L.) also referred to as common flax belonging to the family Linaceae. Linseed is grown for oil and fibre purpose and appears to originate within the Mediterranean region. Linseed is rich in fat, protein and dietary fibre. It contains 40% oil, 30% fibre, 20% protein, 4% ash and 6% moisture. Linseed oil has very healthy fatty-acid profile, with high concentrations (73%) of polyunsaturated fatty acids (PUFAs), Low levels (approximately 9%) of saturated fat and moderate levels (18%) of monounsaturated fatty acids (MUFAs). Linseed has many nutritional and functional properties. Compounds such as polyunsaturated fatty acids, lignans, essential amino acids, vitamin E and dietary fibres makes linseed a rich source to satisfy the basic needs of human diet. Healthy properties of linseed are related to anti-carcinogenic, anti-inflammatory, anti-oxidant activities and to the lowering of cholesterol, prevention of diabetes and decrease of cardiovascular disease.

Cookies may be a baked or cooked food that is typically small, flat and sweet. It always contains flour, sugar and some type of oil or fat. It may also include other ingredients such as raisins, oats, chocolate chips, nuts, etc. Nutritional benefits of linseed and its consumption can be enriched by its incorporation into food products, such as cookies.

## Materials and Methods

**Ingredients:** The major ingredients for the preparation of products were Wheat variety. NIAW-3170 was procured from Wheat Research Station, Niphad, Nashik. All the materials like linseed, vanaspati ghee, sugar and other ingredients were procured from local market.

**Packaging material:** The packaging material viz., LDPE and PP bags were procured from local market and used for packaging of cookies for storage study.

**Treatment Details:** The Linseed cookies were prepared by using different levels of Wheat Flour and Linseed Flour as shown below:

**Table 1:** Treatment details for preparation of Wheat Flour and Linseed Flour Cookies

Treatments	Wheat flour (%)	Defatted linseed flour (%)
CWLF <sub>0</sub>	100	00
CWLF <sub>05</sub>	95	05
CWLF <sub>10</sub>	90	10
CWLF <sub>15</sub>	85	15
CWLF <sub>20</sub>	80	20
CWLF <sub>25</sub>	75	25
CWLF <sub>30</sub>	70	30
CWLF <sub>35</sub>	65	35
CWLF <sub>40</sub>	60	40
CWLF <sub>45</sub>	55	45
CWLF <sub>50</sub>	50	50

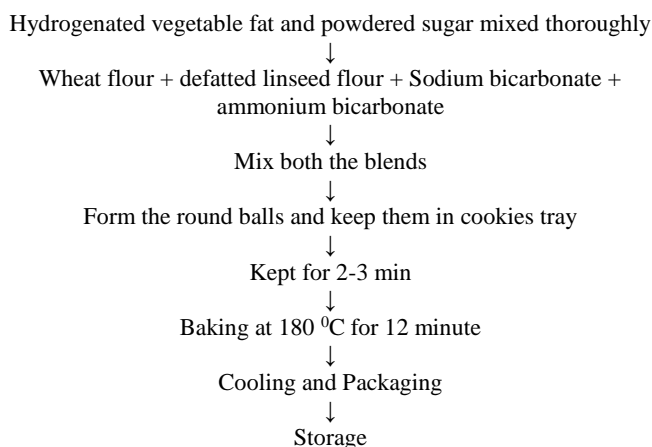
## Method

### Procedure for preparation of defatted linseed flour

Linseed is defatted by using expeller, available at Apex oil mill, Bhistbagh, Dist- Ahmednagar. Defatted flour is further ground in a grinder and passed through sieve of 80 mesh to get uniform flour.

### Preparation of defatted linseed flour cookies

The cookies were prepared using standard levels of ingredients as per the traditional creaming process.



**Fig 1:** Flow chart for preparation of defatted linseed cookies

### Physical characteristics of raw material

The raw material linseed grains were analyzed for different physical characteristics like thousand kernel weight, bulk density and colour.

### Chemical properties of raw materials and cookies

Chemical constituents like moisture, fat, protein,

carbohydrate, crude fiber and minerals like calcium, phosphorous and iron content of raw material and cookies were determined as per the standard procedure.

### Physico-chemical analysis of raw material cookies

The method described in A.O.A.C. (2000) [2] for determining moisture was used. The protein content of cookies was estimated by determining total nitrogen content using standard Micro-Kjeldhal method and fat content of the cookies was estimated by the soxhlet method A.A.C.C (2000) [1]. The crude fiber content in the products was estimated by A.A.A.C. (2000) [1]. The carbohydrate content in the selected cookies were obtained by subtracting from 100, the sum of values of moisture, protein and fat content per 100 g of the sample (Raghuramulu, *et al.*, 1993) [14]. Calcium, phosphorous and iron were analyzed using atomic absorption spectrometry (AAS). These methods give a good precision and accuracy (Ojeka and Ayodele 1995) [13]

### Packaging and storage of defatted linseed cookies

The selected treatments of defatted linseed cookies were packed in LDPE and PP and stored at ambient (30+4°C) for 3 months. The samples were drawn at an interval of 1 month and evaluated for chemical and sensory quality.

### Sensory evaluation of cookies

Sensory evaluation of defatted linseed flour cookies was carried on 9 point hedonic scale. The average scores of the ten judges for different quality characteristics viz. colour and appearance, flavour, texture, taste and overall acceptability were recorded.

### Statistical analysis

All experiments were carried out by using Factorial Completely Randomized Design (FCRD). The results obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010) [15].

## Results and Discussion

### Physical characteristics of raw materials

The results obtained for physical characteristics of linseed grains are presented below:

**Table 2:** Physical characteristics of linseed

Parameter	Linseed
Colour	Light brown
Bulk density (kg/m <sup>3</sup> )	660.20
True density (kg/m <sup>3</sup> )	1045.11
Porosity (%)	33.42
1000 seed wt. (g)	7.49
Angle of repose	21.45°

\*Each value is the average of three determinations

The colour of linseed was light brown. The physical properties bulk density, true density, porosity, 1000 seed wt. and angle of repose were found to be 660.2 kg/m<sup>3</sup>, 1045.11 kg/m<sup>3</sup>, 33.42%, 7.49 g and 21.45°, respectively.

### Chemical characteristics of raw materials

The results obtained for chemical characteristics of wheat and defatted linseed flour are presented here:

**Table 3:** Chemical characters of raw materials

Chemical constituent	Defatted linseed	Wheat
Moisture (%)	3.98	10.41
Protein (%)	41.78	11.03
Fat (%)	5.34	1.81
Crude fiber (%)	8.52	1.73
Carbohydrates (%)	35.24	62.10
Calcium (mg/100g)	249.30	44.08
Iron (mg/100g)	33.80	3.21

\*Each value is the average of three determinations

Chemical characters of various raw materials are comparable with findings reported by Gaikwad *et al.*, (2021) [8] Gopalan, *et al.*, (2006) [9], Similar conclusions have been drawn by Bernacchia *et al.*, (2014) [5], Jiangtao *et al.*, (2019) [11] and Bashir *et al.*, (2006) [4].

### Sensory evaluations of fresh defatted linseed flour cookies

The organoleptic evaluation of cookies prepared by different combination of defatted linseed flour and wheat were carried out. Defatted linseed flour cookies were prepared and presented to panel of ten judge for assessing the quality and acceptability of product. Organoleptic evaluation of cookies was carried out using a 9 point hedonic scale of sensory characteristics such as colour, flavour texture, taste and overall acceptability. The score obtained for sensory evaluation for wheat and defatted linseed flour cookies are shown in Table 4. Wheat and defatted linseed cookies (75 wheat: 25defatted linseed flour) were found the best for

preparation of cookies and stored at ambient temperature ( $30 \pm 4$  °C) for 3 month. Organoleptic quality parameters of a product assume pivotal role in anticipating the consumer response to the product. Colour and appearance uniformity are vital components of visual quality of fresh as well as processed foods and play a major role in consumer choice. Flavour being a combination of taste, smell and mouth feel, has multifaceted impact on sensory quality of a product (Amerine, *et al.*, 1980) [3]. Overall acceptability of product is a function of various factors including colour and appearance, flavour, texture and taste. Amongst all samples for both cookies containing wheat 75 per cent and defatted linseed flour 25 per cent combination was found to be more acceptable. Singh *et al.*, (2000) [17] reported overall acceptability of product like cookies is a function of various factors including colour and appearance, flavour, texture and taste in the soy fortified biscuits storage.

### Selection of Best Combination for Preparation of Defatted Linseed Flour Fortified Cookies

On the basis of organoleptic properties (colour and appearance, flavour, texture, taste and overall acceptability) the best combination from wheat and defatted linseed flour was 75:25. For the storage study these combinations with control (100% linseed) were selected and the cookies prepared from them were used for further storage study. During storage study their nutritional composition, organoleptic properties and microbial quality were analysed using standard procedures.

**Table 4:** Sensory Evaluation of Cookies Prepared from Wheat Flour and Linseed Flour\*

Sample code	Sensory attributes*					
	Colour and appearance	Flavour	Texture	Taste	Overall acceptability	Rank
CWLF <sub>0</sub>	8.4	8.3	8.2	8.0	8.20	6
CWLF <sub>05</sub>	8.5	8.4	8.3	8.1	8.31	5
CWLF <sub>10</sub>	8.6	8.5	8.4	8.2	8.41	4
CWLF <sub>15</sub>	8.6	8.6	8.5	8.4	8.51	3
CWLF <sub>20</sub>	8.7	8.7	8.6	8.5	8.61	2
CWLF <sub>25</sub>	8.8	8.8	8.7	8.6	8.71	1
CWLF <sub>30</sub>	8.3	8.2	8.1	7.8	8.10	7
CWLF <sub>35</sub>	8.2	8.0	8.0	7.7	7.97	8
CWLF <sub>40</sub>	8.0	8.0	7.8	7.5	7.82	9
CWLF <sub>45</sub>	7.9	7.9	7.7	7.3	7.70	10
CWLF <sub>50</sub>	7.8	7.8	7.6	7.0	7.55	11
Mean	8.36	8.32	8.20	7.94	8.17	-
S.E.±	0.006	0.004	0.005	0.013	0.005	-
C.D at 5%	0.018	0.013	0.017	0.039	0.016	-

Maximum score out of 9. All values are mean of ten determinations.

### Whereas

CWLF<sub>0</sub>: (100% wheat flour: 0% linseed flour),  
 CWLF<sub>05</sub>: (95% wheat flour: 05% linseed flour),  
 CWLF<sub>10</sub>: (90% wheat flour: 10% linseed flour),  
 CWLF<sub>15</sub>: (85% wheat flour: 15% linseed flour),  
 CWLF<sub>20</sub>: (80% wheat flour: 20% linseed flour),  
 CWLF<sub>25</sub>: (75% wheat flour: 25% linseed flour),  
 CWLF<sub>30</sub>: (70% wheat flour: 30% linseed flour),  
 CWLF<sub>35</sub>: (65% wheat flour: 35% linseed flour),  
 CWLF<sub>40</sub>: (60% wheat flour: 40% linseed flour),  
 CWLF<sub>45</sub>: (55% wheat flour: 45% linseed flour),  
 CWLF<sub>50</sub>: (50% wheat flour: 50% linseed flour).

### Nutritional value changes in defatted linseed cookies during storage

The average values of fresh cookies (100% Wheat) was moisture increased for treatment CWLF<sub>0</sub> from 4.13 to 4.18, 924~

per cent in LDPE and 4.16 to 4.26 per cent in PP was observed for 90 days of the storage. The sample CWLF<sub>25</sub> showed increase in the moisture content 4.18 to 4.27 per cent in LDPE and 4.21 to 4.28 per cent in PP. Protein decreased for CWLF<sub>0</sub>treatment from 12.68 to 12.63 per cent in LDPE and from 12.65 to 12.60 per cent in PP was observed for 90 days of storage. The sample CWLF<sub>25</sub> showed from 15.06 to 15.01 per cent in LDPE and from 15.03 to 14.98 per cent in PP. Fat decreased for treatment CWLF<sub>0</sub> from 23.87 to 23.70 per cent in LDPE and from 23.84 to 23.65 per cent in PP was observed for 90 days of storage. The sample CWLF<sub>25</sub> showed from 28.93 to 28.76 in LDPE and from 28.90 to 28.74 in PP. Crude fiber decreased for treatment CWLF<sub>0</sub> from 1.72 to 1.68 per cent in LDPE and from 1.71 to 1.66 per cent in PP was observed for 90 days of storage. The sample CWLF<sub>25</sub> showed crude fibre content 4.09 to 4.05 per cent in LDPE and from 4.06 to 4.01 per cent in PP. Carbohydrates decreased for

CWLF<sub>0</sub> from 56.36 to 56.29 per cent LDPE and from 56.31 to 56.24 per cent in PP was observed for 90 days of storage. The sample CWLF<sub>25</sub> showed carbohydrate content 50.24 to 50.17 per cent in LDPE and from 50.21 to 50.15 per cent in PP. Calcium decreased for treatment CWLF<sub>0</sub> from 40.10 to 40.05 mg/100g in LDPE and from 40.06 to 40.01 mg/100g in PP was observed for 90 days. The sample CWLF<sub>25</sub> showed from 110.00 to 109.95 mg/100g in LDPE and from 109.96 to 109.89 mg/100g in PP. Iron decreased for treatment CWLF<sub>0</sub>

from 3.20 to 3.14 mg/100g in LDPE and 3.17 to 3.12 mg/100g in PP was observed for 90 days. The sample CWLF<sub>25</sub> showed from 4.71 to 4.67 mg/100g in LDPE and from 4.68 to 4.65 mg/100g in PP (Table 5). Protein, fat, crude fiber, carbohydrate, calcium and iron decreased in ambient temperature during storage period of 3 month. The decrease in moisture, protein, fat, carbohydrate, crude fiber, calcium and iron was more rapid in the samples stored in PP than LDPE during the storage period.

**Table 5:** Effect of packaging material on chemical properties of wheat flour and linseed flour cookies during storage period

Parameter	Moisture (%)	Protein (%)	Fat (%)	Crude fibre (%)	Carbohydrate (%)	Calcium (mg/ 100 g)	Iron (mg/ 100 g)
<b>Treatment</b>							
CWLF <sub>0</sub>	4.18	12.64	23.77	1.69	56.30	40.06	3.15
CWLF <sub>25</sub>	4.23	15.02	28.83	4.05	50.19	109.95	4.67
S.E. +	0.002	0.002	0.005	0.002	0.003	0.002	0.002
CD at 5%	0.007	0.006	0.015	0.006	0.009	0.006	0.006
<b>Packaging material</b>							
P <sub>0</sub> : Low Density Polyethylene	4.19	13.84	26.32	2.88	53.26	75.03	3.93
P <sub>1</sub> : Polypropylene	4.22	13.81	26.29	2.86	53.23	74.98	3.90
S.E. +	0.002	0.002	0.005	0.002	0.003	0.003	0.002
CD at 5%	0.007	0.006	0.015	0.006	0.009	0.008	0.006
<b>Storage period</b>							
C <sub>1</sub> : 30 days	4.17	13.85	26.38	2.89	53.28	75.03	3.94
C <sub>2</sub> : 60 days	4.20	13.83	26.31	2.87	53.25	75.00	3.92
C <sub>3</sub> : 90 days	4.24	13.80	26.21	2.85	53.21	74.97	3.89
S.E. +	0.003	0.003	0.006	0.003	0.004	0.003	0.003
CD at 5%	0.008	0.007	0.019	0.008	0.011	0.008	0.008
<b>Interaction</b>							
T <sub>0</sub> P <sub>0</sub> C <sub>1</sub>	4.13	12.68	23.87	1.72	56.35	40.10	3.20
T <sub>0</sub> P <sub>0</sub> C <sub>2</sub>	4.16	12.66	23.79	1.70	56.31	40.08	3.17
T <sub>0</sub> P <sub>0</sub> C <sub>3</sub>	4.18	12.63	23.70	1.68	56.29	40.05	3.14
T <sub>0</sub> P <sub>1</sub> C <sub>1</sub>	4.16	12.65	23.84	1.71	56.31	40.06	3.17
T <sub>0</sub> P <sub>1</sub> C <sub>2</sub>	4.20	12.62	23.76	1.69	56.30	40.04	3.15
T <sub>0</sub> P <sub>1</sub> C <sub>3</sub>	4.26	12.60	23.65	1.66	56.24	40.01	3.12
T <sub>1</sub> P <sub>0</sub> C <sub>1</sub>	4.18	15.06	28.93	4.09	50.24	110.00	4.71
T <sub>1</sub> P <sub>0</sub> C <sub>2</sub>	4.22	15.04	28.86	4.07	50.21	109.98	4.69
T <sub>1</sub> P <sub>0</sub> C <sub>3</sub>	4.27	15.01	28.76	4.05	50.17	109.95	4.67
T <sub>1</sub> P <sub>1</sub> C <sub>1</sub>	4.21	15.03	28.90	4.06	50.21	109.96	4.68
T <sub>1</sub> P <sub>1</sub> C <sub>2</sub>	4.25	15.01	28.82	4.03	50.18	109.93	4.67
T <sub>1</sub> P <sub>1</sub> C <sub>3</sub>	4.28	14.98	28.74	4.01	50.15	109.89	4.65
S.E. +	0.006	0.005	0.013	0.005	0.008	0.005	0.005
CD at 5%	0.017	NS	NS	NS	0.022	NS	NS

All values are mean of three replication.

Where, CWLF<sub>0</sub>: Cookies with 100% wheat flour and 0% linseed flour.

CWLF<sub>25</sub>: Cookies with 75% wheat flour and 25% linseed flour.

Hemalatha *et al.* (2006) <sup>[10]</sup> reported that the moisture content in control cookies (3.82%) was less than that of millet (30.00%) incorporated cookies (4.04%). The moisture content was within the critical levels at the end of the storage in LDPE packaging material. Study indicated that cookies and biscuits might be stored satisfactorily for several months at ambient temperature using suitable packaging materials.

Sujitha and Thirumani (2014) <sup>[18]</sup> also reported increase in moisture content from 3.6-5.6% of flaxseed cookies during the storage period of 60 days. This increase was primarily due to packaging material (polythene bags). The packaging was not airtight and lack of temperature control resulted in an increase in moisture contents of cookies. Moreover, cookies absorbed moisture from surrounding atmosphere due to hygroscopic behavior of wheat flour. An increase in moisture contents of cookie samples during storage has also been reported by Butt *et al.*, (2004), <sup>[7]</sup> Budzaki *et al.*, (2014) <sup>[6]</sup> Shariff, *et al.*, (2005) <sup>[16]</sup> either due to atmosphere or packaging materials.

## Conclusion

These results indicates that CWLF<sub>25</sub> cookies (75% wheat and 25% defatted linseed flour) with constant levels of other ingredients *viz.* sugar 50g, vanspati ghee 50g, sodium bicarbonate 1g, ammonium bicarbonate 1g and water 20 ml, respectively. Stored at ambient temperature had better acceptability till 90<sup>th</sup> day. It is evident from all the physico-chemical properties that (75% wheat and 25% defatted linseed flour) are the best in LDPE than PP for preparation of defatted linseed cookies of good quality.

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