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# Studies on sensory evaluation and chemical composition of *Moringa* seed oil biscuits

**Musale SV, Chavan UD, Kharwade SB and Kotecha PM**

**Abstract**
In present investigation, an attempt was made to utilize *Moringa* seed oil into baked products such as biscuits at various levels i.e. 0, 20, 40, 60, 80 and 100% by gradually replacing normal shortening. The effect of different level of incorporation of *Moringa* seed oil on sensory characteristics of biscuits was judged by the semi trained panellist on 9 point hedonic scale. The differences for the sensory characteristics like colour and appearance, texture, flavour, taste and overall acceptability were statistically significant among all the treatments. The biscuits samples prepared with treatment $T_2$ (40% MSO) were statistically superior for overall acceptability parameter over all other treatments to the proportion of same wheat varieties. Nutritional composition of biscuits showed that with increase in MSO level in biscuits do not affects on chemical composition of biscuits significantly. There were nonsignificant changes in moisture, protein, crude fibre and ash content was observed but significantly changes in fat and carbohydrate. The slight non-significant change in calcium, phosphorus, iron and zinc was observed for treatment but significant among wheat varieties.

**Keywords:** *Moringa* seed oil, biscuits, sensory, chemical composition

## Introduction
*Moringa oleifera* belonging to the family *Moringaceae*, native of sub-Himalayan region of northwest India and now grown worldwide within the tropics and sub-tropics. *Moringa oleifera* is the fast growing, soft wood, aesthetically pleasing tree. The tree can be established in slightly alkaline soils up to pH 9 additionally acidic soils as low as pH 4.5 (Shindano and Chitundu, 2008) [22]. *Moringa oleifera* is employed a crucial food commodity which has enormous attention because the 'natural nutrition of the tropics' (Anwar *et.al.*,2003) [7]. It is well known to the traditional world, but currently, its been rediscovered as a multiple use of tree with an amazing kind of potential benefits (Chen *et al.*, 2011) [9]. In India Andhra Pradesh leads in area and production followed by Karnataka, Tamil Nadu and Maharashtra. The seeds of *Moringa* contain 38-42% oil, which is edible vegetable oil. This oil possesses physico-chemical properties similar to those of oil and contains high level of tocophorol
like olive oil (Tsaknis *et al.*,1999) [25]. The oil extracted from *Moringa* is also called as Ben oil or Behen oil and reportedly contains 70% monounsaturated fatty acid as oleic acid, an 18-carbon long monounsaturated fatty acid (MUFA) which makes it suitable for edible purpose because of clear, odorless and good oxidative stability because it allows for extended storage and maximum frying temperature processing (Jessica *et al.*, 2012) [14]. Ben oil is used for household cooking, because its colourless, odourless and resist once to rancidity which enhances the development and retention of taste and natural flavour. (Fuglie, 1999) [11].
Monounsaturated oils have a cardiovascular benefit which lower plasma total cholesterol level to further lowering the chance of heart disease. Other prominent fatty acids in *Moringa* seed oil include palmitic (7.8% and 6.8%), stearic (7.6% and 6.5%), and behenic (6.2% and 5.8%) acids for the solvent and enzyme-extracted oils, respectively (Abdulkarim *et al.*, 2005) [3]. Because of the high monounsaturated to saturated fatty acid ratio, *Moringa* seed oil may will be considered a suitable substitute for highly monounsaturated oils such as vegetable oil like olive oil (Lalas, and Tsaknis, 2002) [16].
Today consumers demand convenience, quality and innovative food products. The *Moringa* seed oil increasing popularity throughout the world as a functional food but in India its use is not much popular. Present study was planned to evaluate the suitability of *Moringa* seed oil in biscuits and to evaluate its effect on the sensory and chemical characteristics of biscuits.

## Materials and Methods

**Wheat grains and *Moringa* seeds:** The raw materials such as wheat varieties *Trimbak* (NIAW- 301) and *Samadhan* (NIAW-1994) are obtained from Wheat Research Station Niphad, Dist.- Nashik. *Moringa* seeds variety PKM-1 procured from S. K. International, Vadodara, Gujrat.

**Extraction of oil :** The oil from *Moringa* seed was extracted by using Soxhlet solvent extraction method (A.O.A.C. 1990). The oil was collected in clean PET bottle and stored for further analysis.

**Treatment details:** The *Moringa* seed oil biscuits were prepared by using different levels of *Moringa* seed oil with vanaspati ghee as shown below:

**Table 1:** Treatments for incorporation of *Moringa* seed oil (MSO)

| Treatments | *Moringa* seed oil (MSO) |
|---|---|
| $T_0$ | 100% vanaspati ghee + 0% *Moringa* seed oil |
| $T_1$ | 80% vanaspati ghee + 20% *Moringa* seed oil |
| $T_2$ | 60% vanaspati ghee + 40% *Moringa* seed oil |
| $T_3$ | 40% vanaspati ghee + 60% *Moringa* seed oil |
| $T_4$ | 20% vanaspati ghee + 80% *Moringa* seed oil |
| $T_5$ | 0% vanaspati ghee + 100% *Moringa* seed oil |

**Preparation of *Moringa* seed oil biscuits:** The biscuits were prepared using standard levels of ingredients as per the traditional creaming process (Fig 1).

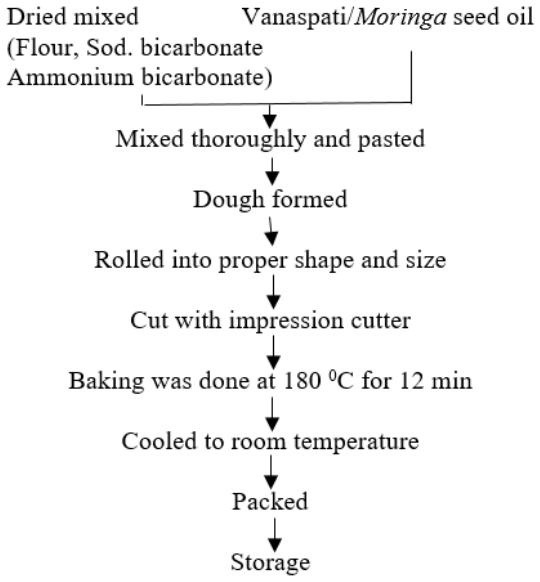


**Fig 1:** Preparation of biscuits

**Proximate analysis:** Chemical constituents like moisture, fat, protein, carbohydrate, crude fiber, ash and minerals like calcium, iron, phosphorous and zinc content of raw material and biscuits were determined as per the standard procedure.

**Sensory evaluation of biscuits:** Sensory evaluation of *Moringa* seed oil biscuits 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 (2009).

## Results and Discussion

### Chemical composition of raw materials

The results obtained for chemical composition of Wheat flour (*Trimbak* and *Samadhan*) and raw *Moringa* seed flour are presented in Table 2. Chemical composition of various raw materials are comparable with findings reported by other scientist Kulkarni *et al*. (2012) [15]; Lande (2016) [17]. These values are also comparable with Jaybhay *et al.* (2014) [13], Farooq *et al.* (2006) [10], Similar conclusions have been drawn by Sodamade *et al.* (2017) [23] and Abiodun *et al*. (2012) [4]. Result obtained in present investigation are in agreement with result obtained by Nzikou *et al.* (2009) [18] and Campas *et al.* (2014) [8].

**Table 2:** Chemical composition of wheat flour (*Trimbak* and *Samadhan*), raw *Moringa* seed flour

| Parameter (%) | Components | | |
|---|---|---|---|
| | Wheat flour | | Raw *Moringa* seed flour |
| | (*Trimbak*) | (*Samadhan*) | |
| Moisture | 14 | 13.82 | 4.80 |
| Fat | 1.82 | 2.2 | 34.36 |
| Protein | 12.76 | 12.06 | 28.62 |
| Ash | 1.9 | 2.1 | 4.06 |
| Crude fibre | 1.8 | 0.9 | 6.75 |
| Carbohydrate | 67.72 | 68.92 | 21.41 |
| Calcium (mg/100g) | 42.22 | 38.16 | 358.75 |
| Phosphorus (mg/100g) | 332.18 | 342.20 | 602.08 |
| Iron (mg/100g) | 7.50 | 5.00 | 8.75 |
| Zinc (mg/100g) | 2.79 | 2.62 | 5.31 |

Each value represents the average of four determination.

### Sensory evaluations of fresh *Moringa* seed oil biscuits

The organoleptic evaluation of biscuits prepared by different combination of *Moringa* seed oil and vanaspati ghee were carried out. *Moringa* seed oil incorporated biscuits were prepared and presented to semi trained panellist for assessing the quality and acceptability of product. Organoleptic evaluation of biscuits 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 *Moringa* seed oil incorporated biscuits are shown in Table 3. The treatment $T_2$ (60% Vanaspati ghee: 40% *Moringa* seed oil) were found the best for preparation of biscuits of good quality.

Organoleptic quality parameters of a product assume pivotal role in anticipating the consumer response to the product (Rey 2006) [20]. Colour and appearance are vital components of visual quality of processed foods and play an important role in consumer acceptance (Alistair 2005) [5]. Flavour being a combination of taste, smell and mouth feel, has multifaceted impact on sensory quality of a product (Amerine, *et al.*, 1980) [6]. Overall acceptability of product is a function of various factors including colour and appearance, flavour, texture and taste. Amongst all samples the biscuits containing 40 per cent *Moringa* seed oil was found to be more acceptable had overall acceptability score was 7.95 (*Trimbak*), 7.92 (*Samadhan*) and showed mean overall acceptability score value was 7.94. Gupta and Singh (2005) [12] reported overall acceptability of biscuits containing colour and appearance, flavour, texture and taste which gives overall acceptance by considering above all attributes. Similar results were obtained by Rangrej *et al.* (2015) [19] for flaxseed oil cookies.

**Chemical composition of *Moringa* seed oil biscuits**

Effects of different levels of *Moringa* seed oil on proximate composition of biscuits showed that with increase in MSO level in biscuits do not affects on chemical composition of biscuits significantly (Table 4). There were non-significant changes in moisture, protein, crude fibre and ash content was observed but significantly changes in fat and carbohydrate.

The moisture content of biscuits ranges from 3.53 to 3.69 per cent (*Trimbak*) and 3.25 to 3.39 per cent (*Samadhan*). The moisture content of biscuits ranges of mean from 3.39 to 3.54 per cent. The present findings are in conformity with the reported results of Sukeerthi and Singh, (2017) [24].

The fat content of biscuits ranges from 25.69 to 27.46 per cent (*Trimbak*), 25.57 to 26.87 per cent (*Samadhan*) and fat content of biscuits ranges of mean from 25.63 to 26.17 per cent. Fat content in biscuits was statistically significant among varieties and treatment. The similar findings of fat content are reported by Rangrej *et al.* (2015) [19]. The fibre content of biscuits ranges from 1.11 to 1.14 per cent (*Trimbak*) and 0.84 to 0.86 per cent (*Samadhan*). The Fibre content of biscuits ranges of mean from 0.98 to 1.00 per cent. The ash content of biscuits ranges from 1.07 to 1.10 per cent (*Trimbak*) and 1.24 to 1.29 per cent (*Samadhan*). The ash content of biscuits ranges of mean from 1.16 to 1.19 per cent. Similar results were obtained by Abdul *et al.* (2010) [2] for cookies were prepared from cottonseed oil. There was a significant change in carbohydrate content. The carbohydrate content of biscuits ranged from 59.71 to 61.19 per cent (*Trimbak*) and 61.19 to 62.26 per cent (*Samadhan*). The carbohydrate content of biscuits ranged of mean from 60.45 to 61.73 per cent.

It was observed from Table 5 that with increased the level of *Moringa* seed oil (MSO) in biscuits, does not affects mineral composition of biscuits. The slight non-significant change in calcium, phosphorus, iron and zinc was observed for treatment but significant among wheat varieties. Calcium content of biscuits from *Trimbak* and *Samadhan* wheat flour in ranged from 35.26 to 35.29 mg/100g and 32.09 to 32.13 mg/100g, respectively. The mean calcium content in ranged from 33.68 to 33.71 mg/100g. Similar results were obtained by Sharoon *et al.* (2014) [21]. Phosphorus content of biscuits from *Trimbak* and *Samadhan* wheat flour in ranged from 343.19 to 343.26 mg/100g and 325.96 to 326.03 mg/100g, respectively. The mean phosphorus content in biscuits ranged from 334.59 to 334.65 mg/100g. There was non- significant change in iron content. Iron content of biscuits from *Trimbak* and *Samadhan* wheat flour in ranged from 4.23 to 4.33 mg/100 g and 2.68 to 2.71 mg/100g respectively. The mean iron content in biscuits ranged from 3.46 to 3.52 mg/100g. Zinc content of biscuits from *Trimbak* and *Samadhan* wheat flour is ranged from 1.92 to 1.96 mg/100g and 2.06 to 2.13 mg/100g, respectively. The mean zinc content of biscuits is ranged from 1.99 to 2.05 mg/100g.

**Table 3:** Sensory evaluation of biscuits prepared with addition of different levels of *Moringa* seed oil

| No. | Treatment | Colour and appearance | | | Texture | | | Flavour | | | Taste | | | Overall acceptability | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean |
| $T_0$ | Control | 8.11 | 8.16 | 8.14 | 8.03 | 8.02 | 8.03 | 8.45 | 8.24 | 8.35 | 8.32 | 8.00 | 8.16 | 8.22 | 8.10 | 8.16 |
| $T_1$ | 20% MSO | 8.04 | 7.75 | 7.90 | 7.55 | 8.00 | 7.78 | 7.91 | 7.50 | 7.71 | 7.64 | 7.75 | 7.70 | 7.78 | 7.75 | 7.77 |
| $T_2$ | 40% MSO | 7.96 | 8.00 | 7.98 | 7.87 | 8.12 | 8.00 | 8.05 | 7.86 | 7.96 | 7.95 | 7.70 | 7.83 | 7.95 | 7.92 | 7.94 |
| $T_3$ | 60% MSO | 7.63 | 7.60 | 7.62 | 7.50 | 7.50 | 7.50 | 7.42 | 7.25 | 7.34 | 7.12 | 7.03 | 7.08 | 7.41 | 7.34 | 7.38 |
| $T_4$ | 80% MSO | 7.15 | 7.12 | 7.14 | 7.05 | 7.00 | 7.03 | 6.68 | 6.65 | 6.67 | 6.60 | 6.50 | 6.55 | 6.87 | 6.81 | 6.84 |
| $T_5$ | 100% MSO | 6.62 | 6.50 | 6.56 | 6.54 | 6.25 | 6.40 | 6.36 | 6.25 | 6.31 | 6.12 | 6.00 | 6.06 | 6.41 | 6.25 | 6.33 |
| | Mean | 7.59 | 7.52 | 7.55 | 7.42 | 7.48 | 7.45 | 7.48 | 7.29 | 7.39 | 7.29 | 7.16 | 7.23 | 7.44 | 7.36 | 7.40 |
| | Factor | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T |
| | SE± | 0.015 | 0.046 | 0.184 | 0.033 | 0.101 | 0.405 | 0.014 | 0.044 | 0.178 | 0.014 | 0.043 | 0.174 | 0.014 | 0.044 | 0.179 |
| | CD @ 5% | NS | 0.132 | NS | NS | 0.291 | NS | NS | 0.128 | NS | NS | 0.124 | NS | NS | 0.128 | NS |

All results are mean of 10 replications. $V_1$ = *Trimbak* $V_2$ = *Samadhan*. MSO= *Moringa* seed oil. NS= Non-significant. Maximum score out of 9.0

**Table 4:** Proximate composition of biscuits affected by wheat variety with incorporation of *Moringa* seed oil

| No. | Treatment | Moisture (%) | | | Protein (%) | | | Fat (%) | | | Crude fibre (%) | | | Ash (%) | | | Carbohydrate (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean |
| $T_0$ | Control | 3.69 | 3.39 | 3.54 | 7.24 | 6.66 | 6.95 | 25.69 | 25.57 | 25.63 | 1.12 | 0.85 | 0.99 | 1.07 | 1.27 | 1.17 | 61.19 | 62.26 | 61.73 |
| $T_1$ | 20% MSO | 3.65 | 3.37 | 3.51 | 7.21 | 6.66 | 6.94 | 25.92 | 25.80 | 25.86 | 1.12 | 0.85 | 0.99 | 1.08 | 1.28 | 1.18 | 61.02 | 62.04 | 61.53 |
| $T_2$ | 40% MSO | 3.61 | 3.32 | 3.47 | 7.24 | 6.65 | 6.95 | 26.42 | 26.29 | 26.36 | 1.14 | 0.86 | 1.00 | 1.09 | 1.29 | 1.19 | 60.50 | 61.59 | 61.05 |
| $T_3$ | 60% MSO | 3.59 | 3.29 | 3.44 | 7.22 | 6.64 | 6.93 | 26.73 | 26.58 | 26.66 | 1.14 | 0.86 | 1.00 | 1.10 | 1.27 | 1.18 | 60.23 | 61.36 | 60.80 |
| $T_4$ | 80% MSO | 3.56 | 3.27 | 3.42 | 7.20 | 6.62 | 6.91 | 26.95 | 26.79 | 26.87 | 1.12 | 0.85 | 0.99 | 1.08 | 1.26 | 1.17 | 60.09 | 61.21 | 60.65 |
| $T_5$ | 100% MSO | 3.53 | 3.25 | 3.39 | 7.12 | 6.61 | 6.87 | 27.46 | 26.87 | 27.17 | 1.11 | 0.84 | 0.98 | 1.07 | 1.24 | 1.16 | 59.71 | 61.19 | 60.45 |
| | Mean | 3.61 | 3.32 | 3.46 | 7.21 | 6.64 | 6.92 | 26.53 | 26.32 | 26.42 | 1.13 | 0.85 | 0.99 | 1.08 | 1.27 | 1.17 | 60.46 | 61.61 | 61.03 |
| | Factor | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T |
| | SE± | 0.004 | 0.013 | 0.051 | 0.014 | 0.043 | 0.174 | 0.011 | 0.035 | 0.139 | 0.002 | 0.006 | 0.025 | 0.003 | 0.009 | 0.038 | 0.011 | 0.033 | 0.133 |
| | CD @ 5% | 0.012 | NS | NS | 0.041 | NS | NS | 0.033 | 0.100 | NS | 0.005 | NS | NS | 0.009 | NS | NS | 0.032 | 0.095 | NS |

Each value represents the average of three determination. $V_1$ = *Trimbak*, $V_2$ = *Samadhan*, MSO= *Moringa* seed oil, NS = Non-significant

**Table 5:** Mineral content of biscuits affected by wheat variety with incorporation of *Moringa* seed oil

| No. | Treatment | Calcium (mg/100 g) | | | Phosphorus (mg/100 g) | | | Iron (mg/100 g) | | | Zinc (mg/100 g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean | $V_1$ | $V_2$ | Mean |
| $T_0$ | Control | 35.29 | 32.13 | 33.71 | 343.26 | 326.03 | 334.65 | 4.33 | 2.71 | 3.52 | 1.96 | 2.13 | 2.05 |
| $T_1$ | 20% MSO | 35.26 | 32.10 | 33.68 | 343.21 | 326.00 | 334.61 | 4.23 | 2.69 | 3.46 | 1.95 | 2.11 | 2.03 |
| $T_2$ | 40% MSO | 35.28 | 32.11 | 33.70 | 343.23 | 326.03 | 334.63 | 4.31 | 2.70 | 3.51 | 1.96 | 2.12 | 2.04 |
| $T_3$ | 60% MSO | 35.29 | 32.11 | 33.70 | 343.20 | 326.02 | 334.61 | 4.31 | 2.70 | 3.51 | 1.95 | 2.12 | 2.04 |
| $T_4$ | 80% MSO | 35.27 | 32.10 | 33.69 | 343.19 | 326.00 | 334.60 | 4.30 | 2.68 | 3.49 | 1.94 | 2.10 | 2.02 |
| $T_5$ | 100% MSO | 35.26 | 32.09 | 33.68 | 343.22 | 325.96 | 334.59 | 4.29 | 2.69 | 3.49 | 1.92 | 2.06 | 1.99 |
| | Mean | 35.28 | 32.11 | 33.69 | 343.22 | 326.01 | 334.61 | 4.30 | 2.70 | 3.50 | 1.95 | 2.11 | 2.03 |
| | Factor | V | T | V × T | V | T | V × T | V | T | V × T | V | T | V × T |
| | SE± | 0.021 | 0.065 | 0.263 | 0.015 | 0.045 | 0.180 | 0.009 | 0.027 | 0.110 | 0.003 | 0.009 | 0.036 |
| | CD @ 5% | 0.062 | NS | NS | 0.043 | NS | NS | 0.026 | NS | NS | 0.008 | NS | NS |

Each value represents the average of three determination. **$V_1$ =** *Trimbak*. **$V_2$ =** *Samadhan*, MSO= *Moringa* seed oil, NS = Non-significant

## Conclusion

The present study suggests that $T_2$ biscuits (60 per cent vanaspati ghee and 40 per cent *Moringa* seed oil) with constant levels of other ingredients can produce superior quality biscuits to prove effectiveness of MSO as bakery shortening. Moreover, the acceptability of sensory characteristics was improved by this fortification. Being carrier of monounsaturated fatty acids, if it is used in proper proportions in biscuits preparation, it could improve the health status of masses. It can be safely used up to 40 percent level of substitution with good consumer acceptance with high nutritional composition.

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