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EFFECT OF TREATED MORINGA OLEIFERA SEED POWDER ON IMPROVING NUTRITIONAL QUALITY OF CAKE

Maha Abdallah Mahmoud[1]*

*Corresponding Author: **Maha Abdallah Mahmoud,** ✉ m_abdulla39@yahoo.com

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Moringa Oleifera tree is referred to as miracle tree because all parts of the plant contains macro and micro nutrients of great importance in human nutrition and medicinal benefits. The objective of this study was to evaluate the nutritional value, physical properties, and sensory evaluation of cakes containing three different concentrations of Treated Moringa Seed powder (TMOS) (10, 20, and 30%) as partial replacement for wheat flour. The results of Nutritional analyses showed significant increase (p<0.05) in crude protein (7.6-17.65%), crude fiber (0.68-1.65%), total ash (1.06-1.97%), calcium (30.06-65.63 mg/100 g) and iron (7.6-17.65 mg/100 g) value with the increase of treated moringa seed powder (TMOS) addition. Cake samples substituted with 20-30% TMOS and equivalent to 80 gm considered nutritious in iron and protein. Physical properties of cake samples revealed that weight and density of cake samples significantly increased. In contrary, texture, volume and specific volume were significantly decreased with the increase in substitution levels of TMOS. Also Sensory evaluation of different substituted cake samples up to 20% TMOS showed no significant differences (P > 0.05) for appearance, aroma, texture, mouthfeel, after taste, and overall acceptability compared with control cake.

Keywords: *Moringa* seeds, Cake, Sensory, Nutritional properties

INTRODUCTION

Moringa oleifera is one of the species in *Moringacae* family and mainly native to India and Africa (Abd El-Baky and El-Baraty, 2013). It is commonly called "benzoil tree", "drumstick tree" or "horse radish tree", "miracle tree". It is important food commodity which has tremendous interest as the natural nutrition of the tropics (Ogunsina *et al.*, 2010). Also it has reasonably priced and readily available source of essential nutrients and nutraceuticals, and it has the possibility to eradicate malnutrition (Anwar *et al.*, 2007; and Kunyanga *et al.*, 2013). Nearly each and every part of Moringa tree (roots, leaves, flowers, green pods, and seeds) is beneficial for functional food preparations, medicinal, nutraceuticals, water purication, and biodiesel production (Adamu *et al.*, 2017). The different parts of this plant contain a profile of important minerals, vitamins, good source of protein, beta-carotene, amino acids, polyunsaturated fatty acids and various phenolics (Anwar *et al.*, 2007; and Adamu *et al.*, 2017). Additionally different parts of moringa oleifera tree have been confirmed as being good sources of unique glucosinolates, flavonoids and phenolic acids (Coppin *et al.*, 2013). The most important advantage of the plant is the medicinal properties such as antioxidant, antiviral, anticancer, cardio-protective, anti-asthmatic, anti-inflammatory and others (Fahey, 2005). According to a review by Oyeyinka and Oyeyinka (2016), the possibilities of food fortication with moringa oleifera leaf, seed, and flower powder to enhance the nutritional value. It is well known

[1] Special Food and Nutrition Department, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

the fortication possibilities in various fundamental foods such as bread, biscuits, yogurt, Amala (stiff dough), ogi (maize gruel) and cheese for making soups. Seeds are used in many countries in different ways: they can be either removed from pods and boiled like peas, can be fried and eaten like peanuts or the oil can be refined and consume as edible oil. A promising alternative in bakery products fortification of using moringa oleifera is the seed or flower. The seeds are recognized as a highly alimentary part of the plant because it is rich in protein with values ranging between 27% to 33% with good balance of essential amino acids, vitamins (such as provitamin A, B and C) and minerals (especially iron calcium, potassium, manganese, zinc and copper (Ogunsina *et al.*, 2010; and Mbah *et al.*, 2012). Compaoré *et al.* (2011) studied the Chemical Composition and Antioxidative Properties of Seeds of Moringa oleifera and reported that Moringa seed flour has high antioxidant (total polyphenols 145.16 mg/100 g, total Flavonoids 144.07 mg/1000 g and total proanthocyanidines 140.49 mg/1000 g). Phenolic act as antioxidant, anti-cancer and antidiabetic agents. Flavonoids are also known to exhibit health beneficial properties on various chronic diseases (Kanadaswami *et al.*, 2005). Additionally moringa seeds contain oil (yield 30-40% w/w) which is also known as ''Ben oil'' and used for the production of biodiesel. Sa´nchez-Machado *et al.* (2015) reviewed that the seeds and seed oil have a high content of oleic (18:1) 70-80%, palmitoleic (16:1) 6-10%, stearic (18:0) 4-10%, and arachidic acid (20:0) 2-4%. This seed oil contains an identical fatty acid profile such as olive oil except for linoleic acid.

In general, snacks including cakes are consumed by different patterns of people. The other name of most snacks is "junk food" or empty foods because they contain high levels of calories from fat or sugar with little protein, vitamin and minerals. American Academy of Pediatrics (2012) reported that Snacks are important for toddlers and preschoolers This is due to the difficulty of getting them for all their nutrient needs by eating the basic meals which is a reason why snacks are important for preschoolers' diet. In addition, Snacks are the favorites of children and teenagers in these stages of life, the nutritional quality and amount of protein are important because of their essential functions in physical and mental development. Cakes are always readily available and loved by children. The addition of Moringa seeds powder to cakes will improve the nutritional value for the diet of children and teenagers that are the major consumers of cakes. Therefore, this research studied the nutritional of proximate composition of Moringa wheat cakes and evaluates its acceptability through sensory evaluation tests.

MATERIALS AND METHODS

Treated Moringa Oleifera Seed Powder (TMOS)

Bulk quantities of dry Moringa oleifera seeds brought from a local market in Giza, Egypt were used for this investigation. The seeds were dehulled and about 2 kg from the bulk was removal of bitterness, by ordinary boiling in clean water for 35 min using a 1:3 w/v ratio. The gruel was decanted and the treated seeds were oven-dried at 80 °C for 8 h (Ogunsina and Radha, 2010). The treated seeds was milled to 140 mm particle size (Hammer mill model No. 79952, Type 120; Falling Number AB, Huddinge, Sweden. Commercial wheat flour 72% extraction was obtained from Cairo Company for Milling and Baking Cairo, Egypt. The other ingredients used, i.e., butter, fresh eggs, commercial grade crystalline sucrose, skimmed milk powder, baking powder and vanillin were obtained from local market, Giza, Egypt. All chemicals and reagents used were purchased from Sigma Chemical Company (St. Louis, Mo., USA).

Preparation of Cake Samples

The cake was prepared according to the method of Akubor (2004). Wheat flour was substituted by Treated Moringa Oleifera Seed powder (TMOS) at the 0% (control), 10%, 20% and 30% levels. After baking, cakes were removed from the pans and left 1 h for cooling. Then, they were placed on coded white plastic plates, and sealed with plastic wraps to

Table 1: Formula of Prepared Cake Samples

Component (gm)	Control	10%	20%	30%
Wheat flour	100	90	80	70
TMOS	Zero	10	20	30
Sugar	60	60	60	60
Skimmed milk	50	50	50	50
Fresh whole eggs	40	40	40	40
* Butter	50	46.5	42.8	39.3
Baking powder	4	4	4	4
Vanalia	1	1	1	1

Note: * It was estimated fat content in the TMOS and deducted from the amount of fat added to the Cake.

prevent drying. Cakes were prepared according to the formula shown in Table 1.

Chemical Analysis

Wheat flour 72% extraction, Treated Moringa Oleifera Seed powder (TMOS), and cake samples made from wheat flour and Treated Moringa Oleifera seed powder blends were analyzed for moisture content, crude protein, crude fiber, crude fat and total ash using the methods described in AOAC (2006). Total carbohydrates were calculated by subtraction of the sum of the crude protein, fat, moisture, and ash from the total weight of the food (Merrill and Watt, 1955). Mineral contents were determined using a Pye Unicuom Sp 19000 atomic absorption spectrophotometer technique.

Nutritional Value of Cake Samples

The nutritional value of servings of 80 g of the cakes as a source of iron and protein was calculated considering the average Daily Recommended Intake for adults (DRI) of 11.3 mg iron/day/2000 K.cal intake and 50 g protein/day/2000 K.cal intake (Federal Register, 1993). The calorific value was calculated using the following Atwater conversion factors: 9 K.cal/g of lipid, 4 K.cal/g of carbohydrate and 4 K.cal/g of protein (Frary and Johnson, 2005).

Determination of Phenolic and Flavonoids Compounds

After methanolic extraction, fractionation and quantification of phenolic compounds were determined using HPLC analysis. High performance liquid chromatography coupled with diode-array was used for detection and determination of phenolic compounds methanolic extracts as mentioned by Zheng and Wang (2001).

Physical Properties of Cake Samples

Weight of different baked cakes was recorded by using sensitive balance (0.1 g). Volumes of cakes were measured using rapeseed displacement method and specific volumes were calculated using the following equation: Specific volume (cm^3/g) = volume (cm^3)/weight (g). Density was measured using the following equation: Density (g/cm^3) = weight (g)/volume (cm^3). All physical properties of cakes were determined according to the methods of AACC (2002). Hardness of the cakes was tested using a texture analyzer type TA.XTZ. The crushing force was determined using a cylindrical pivot, 25 mm in diameter, which entered the cake (20 mm thick and 9 mm deep). The maximum force was recorded in Newtons (N).

Sensory Evaluation of Cake Samples

Sensory analysis was carried out according to Dhingra and Jood (2004) with slight modications. A semi-trained ten trained panelists from Special Food and Nutrition Department, Food Technology Research Institute, Giza, Egypt, was selected for sensory evaluation. Cake samples either control or substituted with different levels of TMOS powder were presented in coded form in white plastic plates. The order of presentation of samples to the panel was randomized. Tap water was provided to rinse the mouth between evaluations. The panelists were instructed to evaluate the coded samples for appearance, aroma, texture, mouthfeel, after teste and overall acceptability. Each sensory attribute was rated on a 10-point hedonic scale (1 = disliked extremely, while 10 = liked extremely).

Statistical Analysis

Data are presented as the mean of three determinations ± standard error. Data were subjected to analysis of variance and means were separated using Duncan multiple-range tests (Statistics Analytical Software, SAS Institute Inc., Cary, North Carolina, USA, 2002).

RESULTS AND DISCUSSION

Chemical Composition of Wheat Flour and Treated Moringa Seed Powder (TMOS)

The chemical composition of wheat flour (72% extraction) and Treated moringa seed powder (TMOS) shown in Table 2. The obtained results indicate that there were significantly high ($P \leq 0.05$) levels of protein (34.08%), fat (36.22%), crude fiber (5.11%) , total ash (3.53%), calcium (50.61±0.39 mg/100 g) and iron(15.39±0.11 mg/100 g) in TMOS powder compared with wheat flour on dry weight. On contrast, total carbohydrates content of TMOS was significantly lower than the corresponding value of wheat flour. These results indicate that TMOS could be considered as a good source of protein, fat, crude fiber and minerals. The calorific value of TMOS was higher than that of wheat flour being 517.69 K.cal /100 g compared with 353.54 K.cal/100 g for wheat flour. These findings encourage the use of moringa olifera seed powder as a good supplementary food in bakery products. The present results are in good agreement with the results of Doweidar *et al.* (2010) for wheat flour and the results of Ogunsina *et al.* (2010) and Chinma *et al.* (2014) for moringa olifera seed.

Nutrient	Wheat Flour (72% Extraction)	Treated Moringa Oleifra Seeds (TMOS)	Sig. (2-tailed)
Moisture (%)	11.64±0.18	8.34±0.27	0.013
Protein (%)	11.13±0.17	34.08±0.29	0
Fat (%)	1.14±0.13	36.22±0.30	0
Crude fiber (%)	0.64±0.04	5.11±0.11	0.001
Total ash (%)	0.53±0.018	3.53±0.10	0.001
Carbohydrates (%)	74.92±0.11	12.70±0.45	0
Calcium (mg/100 g)	10.71±0.1	50.61±0.39	0
Iron (mg/100 g)	1.32±0.18	15.39±0.11	0
Calorific value (K.cal/100 g)	353.54	517.69	-

Table 2: Chemical Composition of Wheat Flour (72% Extraction) and Treated Moringa Oleifera Seed Powder (TMOS)

Note: Mean value and standard error of two determinations.

Chemical Composition of Different Substituted Cake Samples

The results recorded in Table 3 illustrated that there were significant differences ($p \leq 0.05$) in the proximate composition of the various samples of Moringa wheat cake produced in this study when compared to the control. An increase in protein content (7.6±0.25% to 17.65±0.13%) was observed with increase in the level of TMOS addition. This is expected as Moringa is noted for its high quality and quantity of protein. Because Wheat flour lacks certain essential amino acids such as lysine, tryptophan and threonine. Composite flours are thus advantageous in that inherent deficiencies of essential amino acids in wheat flour (lysine, tryptophan and threonine) are supplemented from other sources like legumes (Abu-Salem and Abou-Arab, 2011). Similarly, an increase in fiber (0.68±0.02% to 1.65±0.03%), ash (1.06±0.04% to 1.97±0.04%), calcium (30.06±0.13 to 65.63±0.16 mg/100 g), and Iron (2.84±0.05 to 7.78±0.12 mg/100 g) content of the substituted cake samples were observed with increase in the level of TMOS addition. High ash content is indicative of more mineral elements in the flour blends which could be of immense benefits to the body. On the other hand, total carbohydrates were lower significantly (46.76±0.62% to 35.26±0.11%) as the substitution levels of TMOS powder increased. The present results are in line with previous reports mentioned by Ogunsina *et al.* (2011), Mbah *et al.* (2012), Chinma *et al.* (2014) and Olugbenga *et al.* (2017) who mentioned in their studies that replacing wheat our with moringa seed powder as a nutritional ingredient promises value addition in baked food products especially in protein, fiber, ash, calcium and iron. Also they reported that replacing wheat flour with moringa seed powder decreased the carbohydrate content in these products. However there was no significant difference ($p>0.05$) in moisture content of cake samples compared to the control. The fat content nearly stable in all the samples including control this due to estimated fat

Table 3: Chemical Composition of Different Substituted Cake Samples

Constituents	Control Cake (100% WF)	Cake Samples Substituted with TMOS Powder		
		10% TMOS	20% TMOS	30% TMOS
Moisture (%)	18.22±0.38^a	17.8±0.24^a	18.57±0.24^a	18.11±0.21^a
Protein (%)	7.6±0.25^d	10.8±0.17^c	14.2±0.16^b	17.65±0.13^a
Fat (%)	25.67±0.06^a	25.6±0.06^a	25.13±0.1^a	25.36±0.41^a
Crude fiber (%)	0.68±0.02^c	1.19±0.02^b	1.54±0.06^a	1.65±0.03^a
Total ash (%)	1.06±0.04^d	1.33±0.04^c	1.6±0.01^b	1.97±0.04^a
Carbohydrates (%)	46.76±0.62^a	43.29±0.18^b	38.96±0.27^c	35.26±0.11^d
Calcium(mg/100 g)	30.06±0.13^d	39.22±0.11^c	54.58±0.39^b	65.63±0.16^a
Iron(mg/100 g)	2.84±0.05^d	4.27±0.04^c	6.09±0.08^b	7.78±0.12^a

Note: Mean values in the same row followed by different superscript letters are signiûcantly ($P \leq 0.05$) different from each other.

content in the TMOS (36.22±0.30) and deducted from the amount of fat that added to substituted cake samples. This study concentrated on producing a better nutritional quality cake therefore, adding same quantities of fat to all substituted TMOS samples causing high in calories and undesirable taste.

Nutritional Value of Different Substituted Cake Samples

From the results mentioned in Table 4 for chemical composition of cake samples, nutritional value of different substituted cake samples including: %DRI (daily recommended intake) in terms of iron and protein, classification of cakes according to amount of iron or protein content were calculated and presented in Table 4. Food and drug administration regulation provide for Daily Recommended Intake (DRI) of 11.3 mg iron/day/2000 K.cal diet or 50 g protein/day/2000 K.cal diet (Federal Register, 1993). The cake samples were classified according to the categories proposed by Philippi (2008): food source (containing more than 5% of DRI in a usual serving), good food source (contains between 10% and 20% of the DRI in a usual serving) and excellent food source (contains more than 20% of DRI in a usual serving). So, the %DRI for iron of cake samples was ranged from 20% for control cake to 55.75% for cake sample containing 30% TMOS. It could be recorded that all substituted cake samples were considered to be excellent sources of iron while control cake sample (100% wheat flour) was considered as a good source of iron. Concerning the % DRI for protein of cake samples was ranged from 12.4% for control cake to 27.88% for cake sample containing 30% TMOS. It could be recorded that cake samples containing 20% and 30% TMOS were considered to be excellent sources of protein, while control cake sample (100% wheat flour) and substituted cake sample that contain 10% TMOS were considered as a good source of protein. From the present results it could be concluded that one serving of cake substituted with 20% or 30% TMOS and equivalent to 80 g can be considered nutritious in terms of iron and protein.

Phenolic Compounds and Flavonoids Content of TMOS Powder and Different Substituted Cake Samples

From the results mentioned in Table 5 which showed phenolic compounds fraction, total phenolic contents in TMOS powder and different substituted cake samples, it could be noticed that the methanolic extract of TMOS powder contained 21 phenolic compounds with the highest amounts found for Pyrogallol (16.76), Syringic (2.79), Caffeic (1.66), Vanillic (1.46), Catechein (1.44), Gallic (1.28) and Epicatechein (1.24), respectively, while the other phenolic compounds were found in small amounts. Cake samples contain phenolic compounds ranged from 0.01 mg/100 g to 9.75 mg/100 g with the highest compound being Pyrogallol. The total phenolic contents in TMOS powder recorded 32.942 mg/100 g. An increase in total phenolic content (8.87 to 19.823 mg/100 g) was observed with increase in the level of TMOS addition. This is expected as Moringa because of its high quantity of phenolic contents.

Concerning the total Flavonoids, from Table 6 it could be noticed that the total flavonoids in TMOS powder was 33.85 mg/1000 g, Cake sample containing 100% wheat flour (control cake) was 1.31 mg/1000 g and different substituted Cake samples were ranged from 8.32 mg/1000 g to 30.92 mg/1000 g increasing the substitution levels of TMOS powder in cake making cause a gradual increase in total flavonoids. Cake sample substituted with 30% TMOS powder recorded the highest total flavonoids contents (30.92 mg/1000 g) compared with control cake sample. Data in Table 6 also revealed that the highest amounts found for Luteolin (14.53

Table 4: Nutritional Value of a Serving of 80 g and Classification of Cakes According the Amount of Iron and Protein Provided to Adults

Formulation	Iron DRI = 11.3 mg			Protein DRI = 50 g		
	Serving/mg	% DRI	Classification	Serving/g	% DRI	Classification
Control	2.26	20	Good source	6.2	12.4	Good source
10% TMOS	3.39	30	Excellent source	8.63	17.26	Good source
20% TMOS	4.85	42.92	Excellent source	11.15	22.3	Excellent source
30% TMOS	6.3	55.75	Excellent source	13.94	27.88	Excellent source

Table 5: Phenols Content in Treated Moringa Oleifera Seed Powder (TMOS) and Different Substituted Cake Samples

Components (mg/100 g)	TMOS	Control	10%	20%	30%
Syringic	2.79	1.22	1.38	1.79	4.45
Gallic	1.28	0.04	0.2	0.25	0.47
Pyrogallol	16.76	6.68	7.3	8.94	9.75
4-Amino-benzoic	0.1	0.02	0.03	0.04	0.06
Protocatchuic	0.42	0.21	0.23	0.27	0.32
Catechein	1.44	0.04	0.16	0.32	0.42
Chlorogenic	1.07	0.04	0.04	0.09	0.17
Catechol	1.16	0.19	0.21	0.22	0.24
Epicatechein	1.24	0.05	0.13	0.24	0.42
Caffeine	0.33	0.01	0.03	0.03	0.03
P-OH-benzoic	1.01	0.09	0.29	0.34	0.37
Caffeic	1.66	0.02	0.1	0.11	0.13
Vanillic	1.46	0.01	0.06	0.08	0.31
P-Coumaric	0.78	0.1	0.17	0.27	0.8
Ferulic	0.21	0.03	0.42	0.04	1.43
Ellagic	0.16	0.02	0.02	0.03	0.04
Alpha-Coumaric	0.44	0.01	0.02	0.02	0.02
Benzoic	0.4	0.05	0.14	0.21	0.23
Salycilic	0.13	0.03	0.06	0.09	0.13
Coumarin	0.1	0.01	0.02	0.02	0.03
Cinnamic	0.002	ND	ND	0.002	0.003
Total phenols	32.942	8.87	10.95	13.402	19.823

mg/1000 g) in TMOS powder with ranged from 0.03 mg/1000 g to 7.48 mg/1000 g in different substituted Cake samples and Hisperidin (13.59 mg/1000 g) in TMOS powder with ranged from 0.24 mg/1000 g to 8.58 mg/1000 g in different substituted Cake samples. The present results are in good agreement with findings mentioned by (Compaoré *et al.*, 2011) who suggested that moringa flour has high antioxidant (total polyphenols 145.16 mg/100 g, total Flavonoids 144.07 mg/1000 g) Kanadaswami *et al.* (2005) reported that Phenolic act as antioxidant, anti-cancer and antidiabetic agents and Flavonoids are also known to exhibit health beneficial properties on various chronic diseases.

Table 6: Flavonoids Content in Treated Moringa Oleifera Seed Powder (TMOS) and Different Substituted Cake Samples

Components (mg/1000 g)	TMOS	Control	10%	20%	30%
Narengin	0.81	0.59	0.42	1.76	2.5
Rutin	1.53	0.26	0.77	1.41	2.5
Hisperidin	13.59	0.24	3.07	5.18	8.58
Rosmarinic	1.55	0.02	0.31	0.35	1.11
Quercetrin	1.2	0.12	0.14	0.52	0.62
Quercetin	0.21	0.02	0.05	0.34	0.4
Luteolin	14.53	0.03	3.53	4.24	7.48
Narenginin	0.34	0.03	0.03	0.25	0.43
Kampferol	0.04	ND	ND	0.18	0.28
Hispertin	0.04	ND	ND	0.09	0.28
Apegnin	ND	ND	ND	ND	0.04
7-OH-Flavone	0.01	ND	ND	0.02	0.06
Total flavonoids	33.85	1.31	8.32	14.34	24.28

Physical Properties of Different Substituted Cake Samples

Physical properties of cake samples including: weight, volume, density, specific volume and texture were statistically analyzed and presented in Table 7. All measured Physical properties of the tested samples show significant differences, which indicate that as the substituted levels of TMOS increased, weight and density of cake samples increased. In contrary, volume and specific volume were significantly decreased with the increase in substitution levels of TMOS. Also it could be observed from the results in Table 7 that, the highest increase in weight and density of the prepared cake samples was achieved by substitution of TMOS at level of 30% compared with control (100% wheat flour). No significant difference was observed in weight between the cake sample substituted with 10% and control. The increase in weight of supplemented samples due to the increase of substitution levels may be attributed to the high level of fibers in the supplemented samples which increased

Table 7: Physical Properties of Different Substituted Cake Samples

Cake Samples	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Specific Volume (cm^3/g)	Texture (N)
Control Cake (100% WF)	110.67±1.59^c	160.39±1.07^a	0.689±0.004^d	1.45±0.011^a	21.33±0.59^a
10% TMOS	112.74±0.79^c	151.466±0.37^b	0.744±0.004^c	1.34±0.007^b	15.38±0.42^b
20% TMOS	117.09±0.41^b	143.46±0.87^c	0.816±0.003^b	1.22±0.004^c	14.23±0.14^b
30% TMOS	120.67±0.73^a	134.95±0.24^d	0.893±0.007^a	1.12±0.008^d	12.12±0.18^d
L.S.D	2.879.	1.566.	6.74	0	0.442

Note: Mean with similar superscripts in the same column are not significantly different ($P > 0.05$).

Table 8: Sensory Evaluation of Different Substituted Cake Samples

Cake Samples	Appearance (10)	Aroma (10)	Texture (10)	Mouthfeel (10)	After Taste (10)	Overall Acceptability (50)
Control Cake (100% WF)	9± 0.3^a	9.3± 0.21^a	9.3±0.15^a	9.2±0.25^a	9.1±0.28^a	45.9±1.12^a
10% TMOS	9.±0.21^a	9±0.2^a	9.15±0.15^a	8.58±0.18^{ab}	8.75±0.2^{ab}	44.75±0.7^a
20% TMOS	8.65±0.21^{ab}	8.7±0.21^{ab}	8.95±0.05^{ab}	8.6±0.27^{ab}	8.55±0.16^{ab}	43.45±0.64^{ab}
30% TMOS	8.15±0.26^b	8.25±0.27^b	8.6±0.16^b	8.3±0.21^b	8.1±0.22^b	41.4±0.94^b
L.S.D.	0.61	0.51	0.19	0.53	0.48	7.6

Note: Mean with similar superscripts in the same column are not significantly different ($P > 0.05$).

water absorption and affected weight of samples (Mahfouz *et al.*, 2007). On the other hand, significant decrease in volume and specific volume was observed as a result of increasing TMOS levels. Results in Table 7 show that the volume and specific volume of control cake sample were 160.39±1.07 cm^3 and 1.45±0.011 cm^3/g respectively, which significantly decreased to 134.95±0.24 $cm^3$and 1.12±0.008 cm^3/g for 30% substitution cake sample, respectively. The greater rising volume for control cake sample over the substituted cake samples probably resulted from the high ability of gluten to trap carbon dioxide gas liberated from baking powder (Nielson, 2002). The reduction in volume and specific volume may be due to the influence of TMOS replacing levels on gluten dilution of wheat flour which cause a reduction in gluten strength and consequently on the net-work formed (Hafez, 2004). The present results are in good agreement with the results mentioned by Chinma *et al.* (2014) and Olugbenga *et al.* (2017). Concerning the texture of cake samples substituted TMOS were significantly lower compared with control cake. But no significant deference was observed in texture between the cake samples substituted with 10% and 20% TMOS. Texture is an important trait determining the storage time of cakes and bread. The present results are in good agreement with the results mentioned by Singthong *et al.* (2011) who found that, during cake making increasing the amount of fiber from barley flour or coconut fiber, the hardness was increased (firmer texture), and Ogunsina *et al.* (2011) who reported that there was adverse effect of debittered Moringa oleifera seed our on the volume and texture of bread and cookies.

Sensory Evaluation of Different Substituted Cake Samples

Sensory evaluation of cake samples was considered one of the important tests affecting their acceptability qualities to a large extent. The sensory characteristics, i.e., appearance, aroma, texture, mouthfeel and after taste of cake samples substituted with different levels of TMOS were evaluated by ten panelists the overall acceptability was calculated and the obtained data were statistically analyzed and shown in Table 8. There was no significant differences ($P \leq 0.05$) for appearance, aroma, texture, mouthfeel, after taste, and overall acceptability between control cake and substituted cake samples up to 20% TMOS, but Cake sample substituted with TMOS at level 30% TMOS recorded significant decreases in all sensory characteristics compared with control cake sample. The slight reduction in appearance scores as a result of the addition of TMOS powder in wheat cake could be attributed to variations in particle size. Aroma of food products is associated with the interaction of flavor compounds present when foods are subjected to high temperature. The decrease in aroma of substituted cakes with increasing level of TMOS powder could be attributed to higher bioactive compounds in Moringa than wheat. This trend of result also reflected in the taste attribute of substituted cakes and may be cause a nutty mouth feel. Texture, mouthfeel and after taste of wheat cakes decreased slightly with an increase in the addition of TMOS powder in the blends. The differences among overall acceptability of cake samples were pronounced. There was significant difference for the substituted cake at level 30% TMOS compared with control cake. It is evident that overall acceptability decreased with the increase in TMOS in produced cake samples. The present results are in good agreement with the results mentioned by Chinma *et al.* (2014) who found that. The taste and overall acceptability of composite cakes up to 30% germinated Moringa seed flour substitution were not signicantly ($P \leq 0.05$) different from the whole wheat flour cake. Also the results are agreement with Ogunsina *et al.* (2011) who found that Replacing wheat flour with debittered moringa seed (DBMS) flour as a nutritional ingredient in cookies and bread were acceptable rheological and sensory characteristics at an optimal wheat flour/DBMS blend of 90/10 for bread and 80/20 for cookies. The bread had an acceptable typical, moringa seed taste and the cookies had a nutty mouth feel.

CONCLUSION

Moringa oleifera has been reported to possess some medicinal properties and therefore its inclusion in the diet as nutritional supplement or in the process of fortification of food is highly promising. The moringa seeds can be readily selected and utilized as a remarkable food ingredient to formulate a wide range of products. The addition of Treated Moringa seeds powder (TMOS) to cakes will improve the nutritional value in the diet of children and teenagers that are the major consumers of cakes. The products were rich in protein and other vital nutrients such as iron and calcium that are seldom found in daily diets. It can be concluded that highly nutritious cakes can be prepared by supplementing wheat flour with Treated Moringa seeds powder (TMOS) up to 20%, but Cake sample substituted with TMOS at level 30% TMOS recorded significant decreases in all sensory characteristics compared with control cake sample. This indicates that moringa seeds previously known as a purifying agent for water have good potential as an alternative source of vegetable protein, especially for the malnourished poor in some parts of Asia and Africa.

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