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BY

Ekram, H. Barakat and Yousef, A-R. Eman1

Department of Home Economics, Faculty of Specific Education, Kafrelsheikh University, Egypt[1]

ekrambarakt@yahoo.com

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Evaluation of butter cake prepared by different ratios of oat (*Avena sativa* L.) and wheat (*Triticum aestivum* L.) flour

Ekram, H. Barakat and Yousef, A-R. Eman[1]
Department of Home Economics, Faculty of Specific Education, Kafrelsheikh University, Egypt[1]
ekrambarakt@yahoo.com

ABSTRACT

The main purpose of this study was the utilization of oats flour in preparing butter cakes, as a source of high fiber and bioactive phytochemicals, in the butter cake recipes. Butter cakes were performed by oat-wheat flour blends (10/90, 20/80 and 30/70 w/w) in a butter cake mixture. Obtained organoleptic properties results indicated that the successfully suggested oat-wheat blends butter cake was 20/80 w/w. Incorporate different percentages of oats flour decreased significantly ($P \leq 0.05$) the moisture, ether extract, carbohydrate content and caloric value (Kcal/100g), but crude protein; crude fiber, ash and minerals contents increased significantly ($P \leq 0.05$) with increasing concentrations of oats flour. Prepared cakes were stored at 4±1 ºC for 21 days and rancidity profiles were evaluated. Results showed that, the acid value, peroxide value and thiobarbituric acid (TBA) value trend were low in all substituted cakes than that of the control cake during the storage period. Microbiological quality parameters which included total viable count, yeast and moulds were decreased with an increasing percentage of oats flour. Finally, it could be recommended that the oats flour can be utilized in the preparation of butter cakes until 30/70 substitution levels with wheat flour to improve the quality and safety parameters of butter cakes.

Keywords: butter cakes, oats and quality evaluation

INTRODUCTION

Oats (*Avenal sativa* L.) are the fifth largest cereal crop in the world. Oats have a distinctive nutritional profile compared with other types of grains also, they contain high levels of good quality protective compounds, a greater proportion of unsaturated fatty

acids, high dietary fiber content and both soluble and insoluble fiber **(Daou and Zhang ,2012).** Oat grain is a health-beneficial cereal crop with a high content of multiple nutrient substance **Huijia Mao1 et al (2021) .** Oats are used as food for humans, in oatmeal and cookies. Oat bran has received important attention from the medical community for its role in controlling blood cholesterol levels. Nutrition experts believe that β- glucans, the water-soluble fibers present in oat bran control blood cholesterol levels, which could prevent heart disease. Nutritionists recommend an increased daily intake of water-soluble fibers, such as that in oat bran, because it assists in regulating gastrointestinal function **(Gibson and Benson 2002)**. However, oats have increased in popularity in recent decades with research on the health benefits of fiber and with increasing numbers of people intolerant to wheat. Oat bran contains (67.9%) carbohydrates, (8.6%) fat, (17.1%) protein, (15 to 22%) dietary fiber, (10.4%) β-glucans, (171 mg) magnesium, (1.3 mg) niacin, (6.4 mg) iron, (0.17 mg) copper, (441 mg) potassium and α- tocopherol less than(0.5 mg) **(Saunders, 1985)** Among the many types of bakery products, cakes constitute the larger portion in terms of consumption across the globe **(Azaïs-Braesco et al., 2017).** Nowadays, cake manufacturers face a serious and costly problem caused by microbial spoilage and lipid peroxidation **(Lean and Mohamed, 1999 and Valle Garcia, et al. 2019).** Cakes are a form of sweet favorite dessert with low-fiber composition. Therefore, increasing the percentage of fiber composition in cakes can increase the nutritional quality of these products. **Sreenath et al. (1996)** used different sources of dietary fiber like pineapple waste and hull beans seen in the production of cakes which resulted in about a five percent increase in fiber composition. Therefore, this study was carried out to investigate the utilization of oats flour at different levels in butter cakes preparation. The sensory properties, chemical composition, physicochemical properties and nutritive value of prepared butter cakes were evaluated.

MATERIALS AND METHODS

MATERIALS

Wheat flour (72% extraction rate), oat grains, sugar, eggs, butter, cow milk, sodium bicarbonate and vanilla were obtained from the local market from Kafr El-Sheikh Governorate, Egypt.

METHODS

Preparation of oats flour:

The cleaning of oat grains was performed manually to remove damaged grains, dust particles, other /crops grains and other impurities such as metals and weeds. The grains also ground using a laboratory mill and screened through a 0.25 mm sieve to get flour.

Preparation of cake blends:

Butter cakes were prepared according to the formulas listed in Table (1) according to the procedure described by **Moiraghi et al., (2013)** with slight modification. Wheat flour was substituted with oat flour at ratios 10, 20 and 30 %, all ingredients have been previously equilibrated at room temperature. Then, butter was creamed with sugar using Moulinette machine **(Model 320, cod 25, France)** for 8 min. Next, the rest of wet ingredients were added followed by dry ingredients and mixed under constant mixing. The dough was transferred to greased baking pans and baked in an oven at 160°C for 35 min. After baking, the butter cakes were removed from the pans, left for 1 h at 25°C to cool and then packed in plastic bags to prevent drying. Cake quality attributes were evaluated after 24 h of storage at 25°C. All treatments were prepared in laboratories Home Economics Department, Faculty of Specific education, Kafrelsheikh Univ.

Table (1): Formulation of butter cake with different levels of oat

Ingredients	Formulation of butter cakes	Cake with 10% oat flour	Cake with 20% oat flour	Cake with 30% oat flour
Wheat flour (72%)	250 g	225 g	200 g	175 g
Sugar	100 g	100 g	100 g	100 g
Eggs	150 g	150 g	150 g	150 g
Butter	100g	100g	100g	100g
Milk (mL)	125 ml	125 ml	125 ml	125 ml
Sodium bicarbonate (g)	3.00 g	3.00 g	3.00 g	3.00 g
vanilla	1g	1g	1g	1g
Oat flour	0 g	25 g	50 g	75 g

Sensory evaluation:

The sensory evaluation of the control butter cake and butter cakes containing oat flour at different concentrations by Twenty member's panel consisting of staff members and students of the Home Economics Department Kafrelsheikh Univ., evaluated the produced cakes. The panelists evaluated the butter cakes for taste, color, flavor, texture, appearance, and overall acceptability. Each sensory attribute was rated on a 7 point hedonic scale **(Peter, 2004)**.

Gross chemical composition of oats grain and prepared cake:

Moisture, ash, ether extract, crude protein, crude fiber and non-protein nitrogen contents were measured according to the methods of **A.O.A.C (2000)**. Carbohydrate composition was calculated by differences 100 - (ash + ether extract + crude protein + crude fiber). Caloric value was calculated from the sum of the percentages of crude protein and total carbohydrates multiplied by a factor of 4 (kcal.g-1) plus the crude fat content multiplied by 9 (kcal. g-1) according to **Zambrano et al., (2004) .**

Determination β-glucan of oats grain:

β-glucan content was measured as the method described by **Corr et al., (1990) .**

Determination total phenolic compound of oats grain:

Total phenolic compounds, in oats grain was extracted by reagent using gallic acid as standard according to the method described by **Zhang et al., (2012)**.

Minerals:

Minerals content was determined by digestion of 0.5 g of samples in 10 ml of H2SO4 and one ml perchloric acid in conical flasks according to the method of **(A.O.A.C, 2000)**. Phosphorus was measured according to **Carter, (1993).** Calcium, sodium and potassium were determined by Flame photometer Sherwood, 410 according to **Black (1983)**. Total iron and zinc were determined using atomic absorption spectrophotometer (mode Avanta) as given by **Chapman and Pratt (1961)**.

Physical properties:

Cake height and volume:

The height (cm) of the butter cakes was measured using a digital caliper and the volume (cm3) of the butter cake was calculated using the rapeseed displacement method as described by **AACC (2010)**. Specific lightness for the cake was conducted according to **Kramer and Twigg (1973)**, calculated using the following equation:

$$\text{Specific lightness} = \frac{\text{Volume of cake}}{\text{Weight of cake}}$$

Ink print texture of cake:

Ink print texture test of butter cake prepared from wheat flour (control) and other mixtures was determined according to the method described by **Metwalli (1989)**.

Chemical properties of cakes :

Cakes were stored in the refrigerator for three weeks. The samples were kept in polyethylene bags until analyzed. The oil of cakes was extracted using the Shoxlet app. and the following properties of the extracted oil were analyzed every week.

Acid value (AV) and Peroxide value (PV):

Acid value and Peroxide value of cakes were determined according to the method of **A.O.A.C. (2000).**

Thiobarbituric acid (TBA):

Thiobarbituric Acid (TBA) was determined according to the method of **Tarladgis et al., (1960)**. Calculation: TBA value (as mg malonaldehyde per kg sample) =7.8 X A where A = absorbance of sample vs blank

Nutritive value of cakes:

Daily needs of energy and protein:

Grams consumed of food to cover the daily needs of energy and protein for adults (25–50 years) were calculated using the daily requirements for adults (2900 Cal/day) for energy and (63g/day) for protein as given by **Anonymous (1989).** The GDR of energy (g) was calculated using the following two equations reported by **(Anonymous 1985).**

$$\text{G.D.R.of energy (g)} = \frac{\text{Energy daily requirements of adult man (2900 Cal/day)}}{\text{Energy value (Kcal/100 g food)}}$$

$$\text{G.D.R.of protein (g)} = \frac{\text{protein daily requirements of adult man (63g/day)}}{\text{protein content (63g/100 g food)}}$$

Percent satisfaction of energy and protein:

Percent satisfaction of daily requirements of energy and protein for an adult man (25- 50 year) when an adult 200 g of sample (P.S/200) were calculated using the following two equations reported by **(Anonymous, 1989).**

$$\text{P.S. of energy (\%)} = \frac{200 \text{ X ENERGY VALUE (Kcal/100g sample)}}{\text{Energy daily requirements of adult (2900 Cal/day)}} \text{X100}$$

$$\text{P.S. of protein (\%)} = \frac{200 \text{ X g protein /100g sample}}{\text{protein requirements of adult (g/day)}} \text{X100}$$

Microbiological examination:

Samples were prepared using the methods of **Anonymous (1996).** Total viable bacteria, yeasts, molds, and Coliform bacteria, were carried out according to the methods given by **Kiss (1984).**

Statistical analysis:

Statistical analysis was done using **SPSS (2008)** Version12 program for windows.

RESULTS AND DISCUSSION

Chemical composition of Raw oat grain:

Oats grain has high levels of protein, lipids and dietary fibers. From the results mentioned in Table (2), the chemical contents of oats grain contains 10.86% moisture, 11.13% protein, 7.50% fat, 4.45% ash, 11.70% crude fiber, 3.15 g/100g β-glucan and 0.62 mg/g total phenolic compounds. These results are in agreement with those obtained by **Marwa S. Mousa et al (2022) , Huijia Mao1 et al (2021)** .

Notably, the β-glucan of oat has a higher molecular weight than the β-glucan from other cereals **(Bozbulut and Sanlier, 2019).** β-glucan is the major soluble fiber found in barley and oat compared to other cereals, barley and oats have relatively high levels of β-glucan. This was confirmed by results obtained in Table (2) which

found that oats grain contained 3.15 g/100g. Also the total phenolic compounds of oats grain was o.62 mg/g as gallic acid. These results are in line with those of **(Mikulajov et al., 2007).** who reported that total phenolic contents ranged from 0.758 g.kg-1 to 1.244 g.kg-1 in oat genotypes

The obtained results showed that oats grain in addition to being the primary source of carbohydrates, is also provided by phenolic compounds as bioactive compounds.

Table(2): Chemical composition of Raw oats grain (on dry weight bases g/100g).

Constituents %	Oats grain
Moisture	10.86 %
Protein	11.13 %
Fat	7.50 %
Ash	4.45 %
Crude fiber	11.70 %
β-glucan	3.15 g /100g
Total phenolic compound	0.62 mg/g

Sensory evaluation of butter cakes prepared with different levels of oat flour:

Sensory evaluation is still the most satisfactory way of assessing the quality of many products. Sensory evaluation of prepared butter cakes is presented in Table (3). The taste, texture and overall acceptability of the cakes were improved when oat flour was added to 20%, while the addition of 30% oat flour recorded a low score in all properties of the cake compared with the control cake but it was not inferior . The obtained results were in agreement with those of **El-Sheikh (1999).** Flavor and appearance were the highest score in the control cake (7.00 and 6.75) followed by cake containing oat 10% (6.65 and 6.35) and the lowest score was for a cake containing oat 30% (6.17 and 5.45) respectively. Colour decreased with an increase in oats percentage from (0 to 30%), The crust colour was attributed to the Maillard reaction between proteins and sugars. The reaction commences above 150 °C, these reactions also produce the aroma and flavor of baking **(Wiggins, 1998).**

The statistical analysis supported these findings (at $P \leq 0.05$). Regarding the overall acceptability, it can be concluded that the

addition of oat fiber of up to 20% resulted in butter cakes with higher approval by the panelists. These results are in accordance with those reported by **Majzoobi et al., (2015).**

Table (3): Sensory evaluation Score of butter cakes prepared using different levels of oat flour.

properties / Substitution levels (%)	Taste	Colour	Flavour	Texture	Appearance	Over all Acceptability
Control cake	6.70^{a}	6.65^{a}	7.00^{a}	6.10^{b}	6.75^{a}	6.80^{a}
Cake with10% oat	6.20^{b}	6.25^{ab}	6.65^{ab}	6.30^{b}	6.35^{b}	6.75^{a}
Cake with20% oat	6.75^{a}	6.15^{b}	6.50^{ab}	6.79^{a}	6.20^{b}	6.80^{a}
Cake with30% oat	5.70^{c}	5.75^{c}	6.17^{bc}	5.65^{c}	5.45^{c}	5.25^{b}

Mean values in each column having different subscript(a, b, c) are significantly different at $p < 0.05$.

Gross chemical composition and caloric value of butter cakes prepared using different levels of oats flour:

Data in Table (4) show the proximate chemical composition (g/100 gm) of prepared butter cakes. It could be observed that moisture content was decreased by increasing the levels of oat flour, which ranged from(22.18 to 19.18). The highest value of moisture content was found in the control cake. These results were in line with those of **Vijayakumar *et al.*, (2013),** who observed that moisture content decreased with the increase of oat and finger millet flour content in the composite cookies. Concerning crude protein content, all studied cakes ranged from 10.17 to 13.21% .Cake with 30% oat flour recorded the highest protein value (13.21 %).The lowest crude protein value was found in the control cake (10.17). In contrast, the content of fat was decreased in butter cakes, the highest value was detected in control cake (15.41%), while the lowest value was in the 30% oats cake (8.52%). It's clear that fat content showed a significant decrease at ($P<0.05$). Ash, carbohydrates and fibers were significantly increased in all cakes with oat flour at ($P< 0.05$) compared with control cake, the highest

values were noticed in cakes with 30% oats flour. **El-Qatey et al., (2018)** showed that increase in protein, ash, fat and fiber were observed in biscuits fortified with oats in a ratio of 10, 20, 30, 40 and 50% from 8.01 to 8.61%, 1.27 to 1.69%, 15.14 to15.66% and 3.43 to 4.87%, respectively.

The highest carbohydrates composition of the control cake may be due to high level of wheat flour and this agree with **Arafa (2009)** , who reported that wheat flour (72% extraction rate) involves a high composition of carbohydrates. On the other hand, results indicate that the substituting of oats flour causes reducing in the caloric value; this was observed to be in the range between (449.10 to 405.56) Kcal/100g. **Ibrahim *et al.*, (1990)** reported that many forms of dietary fiber have been added to bread and other cereal based-products. It is possible to formulate satisfactory high fiber bread (15-20% cellulose) wheat bran and oats bran are used in bread making.

Table (4): Gross chemical composition and caloric value of butter cakes prepared by different levels of oat flour (on dry weight bases g/100g).

Constituents / Substitution levels (%)	Moisture	Crude protein	Ether extract	Ash	Crude fibers	Carbohy-drates	Caloric value (Kcal/100g)
Control cake	22.18 ^{a}	10.17^{d}	15.41^{a}	0.85^{d}	1.30^{d}	76.14^{a}	449.10
Cake with10% oat	21.83^{b}	11.95^{c}	11.10^{b}	2.68^{cb}	3.75^{c}	71.51^{b}	424.83
Cake with20% oat	20.33^{bc}	12.72^{b}	9.39^{c}	3.16^{ab}	4.86^{b}	69.87^{c}	414.87
Cake with30% oat	19.18^{c}	13.21^{a}	8.52^{d}	3.73^{a}	5.53^{a}	69.10^{cd}	405.56

Mean values in each column having different subscript(a, b, c) are significantly different at $p < 0.05$.

Minerals content of butter cakes prepared using different levels of oat flour

Cereals are excellent sources of minerals. The results in Table (5) indicated that butter cakes prepared using different levels of oats flour have very high levels of all minerals compared with control.

There are significant differences between control and all treatments. The addition of oats flour increased the mineral contents of butter cakes by increasing its substitutions level. The increase in calcium, sodium, potassium and phosphorus contents of butter cakes came in agreement with those of **Ruxton and Derbyshire (2008)**,who stated that, oats contain a wealth of micronutrients and are recognized as a source of iron, potassium, copper and magnesium, as well as a rich source of thiamine, folate, zinc and phosphorus. These results are in agreement with those obtained by **Marwa S. Mousa et al (2022)** who found that the Oat flour was rich source of K, Ca, Mg, Na, Fe, Mn and Zn which were 367.0, 78.52, 118.0, 6.74, 18.30, 5.2 and 3.6 mg/100 g on dry weight, respectively.

However, **Ishida et al., (2000)** reported that, one mg/day of iron is suitable for adults to maintain the daily balance of intake and excretion. Thus, all treatments contained suitable amounts of iron. **Shills and Young (1988)** reported that if the Ca/P ratio is lower than 0.5, a high amount of calcium may be lost in the urine, resulting in a decrease in the calcium levels of bones. In this relation, the Ca/P ratio of tested butter cakes was considered a good source of minerals required for bone formation and when the oats flour levels were increasing, the Ca/P ratio was induced. The ratio of K/Na in the diet is an important factor in the prevention of hypertension and arteriosclerosis, since K depresses and Na enhances blood pressure **(Yoshimura et al., 1991).** Results indicated that with increasing levels of oats flour, the K/Na ratio seem to be lower, however the K/Na ratio was low and that could be supplemented by the butter cakes with potassium.

Generally from the above-mentioned data, it could be concluded that the addition of oat flour to butter cake changed the minerals content and could be considered an important source of minerals.

Table (5) Minerals content of butter cakes prepared using different levels of oat flour (mg /100g) Compared to cake control

Substitution levels (%)	Calcium (Ca)	Sodium (Na)	Potassium (K)	Iron (Fe)	Zinc (Zn)	Phosphorus (P)	Ca/P ratio	K/Na ratio
Control cake	31.78 ^{d}	4.55 ^{c}	3.95 ^{c}	2.02^{c}	0.18 ^{c}	48.95 ^{d}	0.60	0.87
Cake with 10% oat	34.42 ^{c}	4.68 ^{b}	4,18 ^{ab}	2.75^{b}	0.32 ^{b}	50.33 ^{c}	0.70	0.89
Cake with 20% oat	35.91 ^{b}	4.85 ^{ab}	4.32 ^{a}	3.02^{a}	0.52^{ab}	51.40 ^{b}	0.70	0.89
Cake with 30% oat	36.82 ^{a}	5.05 ^{a}	4.53 ^{a}	3.24^{a}	0.63 ^{a}	52.32 ^{a}	0.70	0.90

Mean values in each column having different subscript(a, b, c)are significantly different at $p < 0.05$.

Some physical properties and ink print texture of prepared butter cakes

Cake's physical properties are interesting as they are related to the acceptance of consumers. Some physical properties of backed butter cakes produced using different percentages of oats flour had a clear effect on cake height, weight, volume and specific lightness as shown in Table (6). The highest cake value of height (6.15 cm) was obtained at 30% oat flour, but the lowest height was 4.65 cm. The specific lightness of the butter cakes decreased slightly from 2.742 to 2.730 g cm3 as the percentage of the oat flour increased from zero up to 30%. These findings may be related to the increment of the bulking agent in cake butter as a result of adding sweeteners during the baking process as explained by **Labell, (1992).** Therefore, the highest volume (1237cm3) was obtained for the treatment containing 30% oat flour, but the lowest volume was obtained for the control cake (1220 cm3). When fiber-enriched materials were incorporated into the cake formulation, the volume of the cakes seemed to be reduced and their texture become harder as reported by **Jun et al., (2014)**

Table (6): Effect of using different oats flour levels on some physical properties of butter cakes Compared to cake control

Substitution levels %	Cake height (cm)	Weight (Gm)	Volume (Cm3)	Specific lightness
Control cake	4.62 d	445 b	1220 d	2.742 a
Cake+ oats 10%	4.84 c	448 ab	1228 c	2.741 a
Cake+ oats 20%	5.56 b	450 a	1232 b	2.738 b
Cake+ oats 30%	6.15 a	453 a	1237 a	2.730 bc

Mean values in each column having different subscript(a, b, c)are significantly different at $p < 0.05$.

picture 1 and 2 showed the cross-section and texture of the butter cakes containing different levels of oat flour. It is clear from these picture that the cake formulations using different ratios of oat flour as a substitution for wheat flour had lower sponginess and big unregulated cells compared with the control cake. Concerning the pictures in picture (2), the texture of the cake was affected by adding oat flour as a substation of wheat flour, the crump cell walls became thicker and more compact, especially with these prepared using oats flour. It could be also observed that the sponginess and cells regulation of cake decreased with an increase in substitution ratio. The influence of oats flour on butter cake slows down the rate of gas diffusion, providing enough strength for the butter cake **(Capriles et al., 2008 and Lebesi and Tzia 2011)**. On the other hand, **Marina et al., (2016)** mentioned that the decrease in the number of air cells and increase in the cell size of fat-replaced cakes resulted in harder cakes, which was reflected in the texture profile analysis.

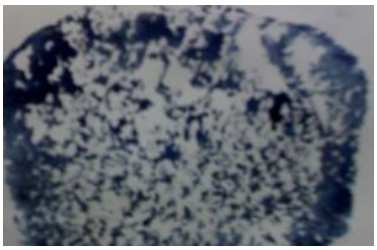
(1): Control cake

(2): Cake substituted with 10% oats flour

(3): Cake substituted with 20% oats flour

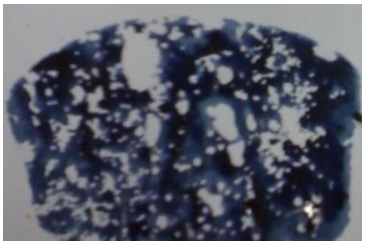
(4) Cake substituted with 30% oats flour

picture 1. Cross section of the butter cakes containing different percentage of oat flour.

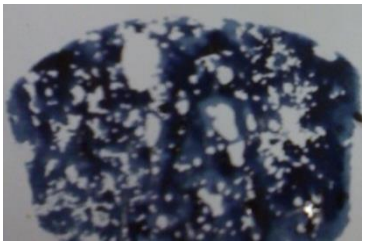


(1): Ink print of crump cell of control cake.

(2): Ink print of crump cell of cake with 10% oats flour



(3): Ink print of crump cell of cake with 20% oats flour.



(4): Ink print of crump cell of cake with 30% oats flour

picture 2.Ink print of crump cell of butter cakes containing different levels of oat flour.

Lipid peroxidation of butter cakes prepared using different levels of oats flour

Bakery products such as butter cakes particularly those with high lipid content tend to become rancid after prolonged storage owing to the oxidation of fatty acids **(Ray and Husain 2002 and Smith et al., 2004).** Data given in Table (7) show acid (AV), peroxide (PV) and thiobarbituric acid (TBA) values of butter cakes during the storage period for three weeks at room temperature. The acid value is a measure of the free fatty acid contents of oil/fat. It is an index of the measurement of the

freshness of fat. Humidity and high temperature result in an increase in the acid value due to the hydrolysis of glycerides into free fatty acids. Higher values indicate undesirable changes as it not only results in greater refining losses but also increases the susceptibility of fats to rancidity. From the obtained results, it could be found that butter cakes containing 30% oat flour recorded the lowest value of AV (0.40 to 0.55 mg. KOH/g oil) during 3 weeks of storage compared with control cake (0.44 to 0.77 mg. KOH/g oil), respectively. Significant differences were noticed between cakes containing oat flour and control cake. The measurement of rancidity in fats and fats can be carried out by different methods according to the type of rancidity. It is generally accepted that the first product formed by the oxidation of fat is a peroxide or hydroperoxide. The most common method of measurement is therefore the peroxide value **(Hamilton and Kristein, 2003)**. On the other hand, results indicated that PV was gradually increased with increasing storage periods for three weeks. At zero time the PV values ranged between 2.60 and 2.22 meq. O2/ Kg oil, the highest value was noticed in the control cake. After three weeks PV also, increased compared with zero time. Butter cake manufacturers face a big problem of lipid oxidation that limits the shelf-life of their products **Lean and Mohamed (1999).**

From the same Table (7), data show that the thiobarbituric acid (TBA) value ranged between 0.57 to 0.50 mg / kg-1 of the sample at zero time; the highest value was noticed in the control cake. During the storage period there were significantly lower ($p< 0.05$) in thiobarbituric acid values of all prepared cakes with oats flour compared with the controlcake. At the end of storage (three weeks) all treatments including the controlsample resulted as rancid but still acceptable. The thiobarbituric acid value for the control cake exhibited more than 1.0 mg / kg-1 of the sample after three weeks of storage. All treated samples resulted in significantly lower ($p< 0.05$). A thiobarbituric acid value less than 0.576 mg / kg-1 of the sample is called not rancid, whereas values of 0.65-1.44 mg/ kg-1 of the sample are regarded as rancid but still acceptable and values greater than 1.5 mg/ kg-1 of the sample are said to be rancid and unacceptable **(Ke et al., 1984)**.

Foods containing a higher content of polyunsaturated fatty acids are more prone to oxidation **Aardt et al., (2004).** Slow rises in TBA values were observed for all substituted cakes. The TBA value was not increased progressively during storage and can be considered as an indicator of oxidative degradation. Antioxidant activity has been identified in oat including vitamin E, flavonoids, phenolic compounds and phytic acid **(Shahidi and Naczk 1995)** and antioxidants function in helping to maintain the stability of processed oat products, and oat can stabilize oils and fats against rancidity. A significantdecrease (P< 0.05) were observed between control cake and prepared cakes with oats in all parameters

Table (7): Acid value, peroxide value and thiobarbutaric acid value of butter cakes prepared using different levels of oats flour during cold storage (at 4±1 °C for three weeks).

Substation levels (%)	Storage Time (weeks)											
	0			1			2			3		
	AV	PV	TBA	AV	PV	TBA	AV	PV	TBA	AV	PV	TBA
Control cake	a 0.44	a 2.60	a 0.57	a 0.47	a 3.27	a 0.69	a 0.58	a 4.28	a 0.85	a 0.77	a 4.93	a 1.23
Cake+ oats 10%	a 0.42	ab 2.47	a 0.53	a 0.44	b 3.08	b 0.59	ab 0.55	b 3.32	b 0.67	b 0.70	b 3.86	b 0.83
Cake+ oats 20%	ab 0.40	b 2.38	a 0.53	b 0.41	c 2.74	b 0.56	b 0.52	cb 3.16	b 0.63	c 0.64	c 3.47	c 0.68
Cake+ oats 30%	ab 0.40	b 2.22	ab 0.50	b 0.40	d 2.55	cb 0.54	cb 0.47	cb 3.00	c 0.58	d 0.55	cd 3.22	c 0.63

Mean values in each column having different subscript are significantly different at p< 0.05

Where: AV.mg KOH/g oil, PV. Meq. O2/ Kg oil, TBA. mg malonaledehyde per kg sample.

Nutritive values of butter cakes prepared using different ratios of oats flour :

The calculated nutritive values of protein and energy are presented in Table (8). The data in this table show the energy value (100g/Kcal), G.D.R. of protein, energy (g) and P.S./200 for

protein, energy (%) of backed butter cakes prepared using different levels of oats flour and control.

Concerning to grams of cakes consumed to cover the daily needs of protein or energy (G.D.R), the results indicate that the values for protein and energy (100g/Kcal) were higher in the control treatment than that of other treatments prepared using different levels oats flour, this may be due to decrease in the content of protein value and increase of fat and carbohydrate. The percent satisfaction of the daily requirements of protein for an adult man when consuming 200 g of cakes (P.S/200) was higher in all treatments prepared using different levels of oat flour than in the control treatment ranging between (32.29 to 41 94%) . On the other hand, the PS/200 for the energy of all cake treatments prepared using different levels of oatsflour were noticeably lower than the control butter cakes.

Table (8): Nutritive value of butter cakes prepared using different ratios of oat flour.

Substitution levels (%)	Nutritive values				
	Kcal/100g	G.D.R for protein (g)	P.S./200 for protein (%)	G.D.R for energy (g)	P.S./200 for energy (%)
Control cake	449.10	6.20	32.29	6.46	3097
Cake with 10%oats	424.83	5.27	37.94	6.83	2930
Cake with 20%oats	414.87	4.95	40.38	6.99	2861
Cake with 30%oats	405.56	4.77	41.94	.157	2797

G.D.R: Gram consumed of food to cover the daily needs of protein or energy for adult man.

P.S./200: Percent satisfaction of the daily requirements of protein or energy for adult man when consumed 200 g of sample.

Microbial examination of butter cakes prepared using different ratios of oat flour:

Data in Table (9) showed the microbial count in butter cakes prepared using different levels of oats flour during cold storage (at 4±1 ºC for 21 days). At zero time the total viable count, molds

and yeasts (cfu/g) were highest in the control cake than in cakes prepared using different levels of oatsflour. Results indicated that, substituting oats flour decreased the total viable bacteria, moulds and yeasts counts with increasing the levels of oat flour. After three weeks of storage, the highest value observed in the control cake was 6.20 × 102and 7.30 × 102 both the total viable count, moulds and yeasts (cfu/g), respectively while, the lowest value was detected in cake with 30% oat 3.60 × 102 and 4.10 × 102 both the total viable count, moulds and yeasts (cfu/g), respectively.

To prevent fungal spoilage of intermediate moisture bakery products like cakes and in consequence extend their shelf life, chemical preservatives are normally used **(Mohammadzadeh-Aghdash et al. 2018)**. However, in this study, the addition of oats flour leads to prolonging the shelf life of cakes prepared using different levels of oat flour during a cold storage period this may be due to the presence of an anti-microbial agent in oats flour. At the same time, the coliform bacterial count (cfu/g) was not detected in all treatments under investigation.

Table (9): Microbial examination of butter cakes prepared using different ratios of oat flour during cold storage (at 4±1 ºC for three weeks).

Microorganisms / Storage period	Total viable count (cfu/g)				Moulds and yeasts (cfu/g)				Coliform group (cfu/g)			
	Zero time	1st week	2nd week	3rd week	Zero time	1st week	2nd week	3rd week	Zero time	1st week	2nd week	3rd week
Control cake	1.70 × 10	4.10 ×10	3.70 ×10^2	6.20 × 10^2	1.30 × 10^2	2.70 × 10^2	3.90 × 10^2	7.30 × 10^2	ND	ND	ND	ND
Cake with 10% oat	1.50 ×10	3.60 ×10	2.90 × 10^2	4.30 × 10^2	1.26 × 10^2	2.45 × 10^2	3.49× 10^2	5.50 × 10^2	ND	ND	ND	ND
Cake with 20% oat	1.50 ×10	3.20 ×10	2.79 × 10^2	3.65× 10^2	1.23 × 10^2	2.27 × 10^2	2.70 × 10^2	4.30 × 10^2	ND	ND	ND	ND
Cake with 30% oat	1.20 ×10	2.70 ×10	2.55 × 10^2	3.60 × 10^2	1.10 × 10^2	2.20 × 10^2	2.40 × 10^2	4.10 × 10^2	ND	ND	ND	ND

ND = not detected Cfu = colony form unit

Conclusion:

Finally, it could be concluded that utilization of oats flour especially 20%for preparation of butter cakes improved the quality attributes of product increased shelf life of cake products through storage period this may be due to oats flour their contents of antimicrobial agents, and overall results showed that it is possible to prepare cakes with similar physical and sensory characteristics to the control when flour was substituted by different percentages(10,20 and30) of oats flour, as to the addition of oat flour led to increased contents of crude protein and crude fiber, a high nutritive value due to the high content of protein.

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الملخص العربي

تقييم كيك الزبدة المحضرة بنسب مختلفة من دقيق الشوفان (*Avena sativa* L.) ودقيق القمح (*Triticum aestivum* L.)

إكرام حفناوي بركات –إيمان عبد ربه يوسف

قسم الإقتصاد المنزلى – كلية التربية النوعية – جامعة كفرالشيخ

ekrambarakt@yahoo.com

الهدف الرئيسي من هذه الدراسة هو استخدام دقيق الشوفان ، كمصدرعالى للألياف والمركبات الحيوية النشطة ذات المصدر النباتى في إعداد كيكة الزبدة. تم إعداد كيك الزبدة من خليط دقيق الشوفان والقمح (90/10 ، 80/20 و 70/30 وزن شوفان/وزن قمح) في خليط كيكة الزبدة. حيث اسفرت الدراسة الخاصة بنتائج الخواص الحسية التي تم الحصول عليها إلى نجاح كيك الزبده بالخليط المقترح 80/20 وزن شوفان/وزن قمح. وقد وجد انه بدمج نسب مئوية مختلفة من دقيق الشوفان لدقيق القمح في المخاليط المختلفه انخفاض معنوي ($P\leq0.05$) بكلا من الرطوبة ، والدهون ، ومحتوى الكربوهيدرات والقيمة الحرارية (Kcal / 100g) ، ولكن كان هناك زيادة معنوية في محتوى البروتين الخام والألياف الخام والرماد والمعادن ($P\leq0.05$) مع زيادة تركيز دقيق الشوفان. تم تخزين الكيك على درجه حراره 1±4م° لمدة 21 يوما، وجرى تقييم مؤشرات التزنخ وأظهرت النتائج أن رقم الحموضه وقيمة البيروكسيد و قيمة حمض الثيوبارابيوتريك كانت أقل في جميع المعاملات عن الكنترول خلال فترة التخزين. وأن معايير الجودة الميكروبيولوجية مثل إجمالي عدد البكتريا الكلي والخمائر والاعفان قلت مع إضافة المزيد من دقيق الشوفان. أخيرًا، يمكن التوصية باستخدام دقيق الشوفان في تحضير كيك الزبدة حتى 70/30 (وزن شوفان/ وزن قمح) الاستبدال بدقيق القمح لتحسين معايير جودة كيكة الزبدة، تصبح أكثر صحة وأمانًا.