Characteristics of Mango Seed Kernel Butter and its Effects on Quality Attributes of Muffins

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ABSTRACT

Mango seed kernel contained a considerable amount of butter (21%). The butter had melting point of 32°C, acidity 0.76 %, peroxide value 2.782 meq/kg and iodine value 55.15, indicated that the characteristics of mango seed kernel butter (MSKB) are in the normal range of edible oils. Stearic acid was the predominant fatty acid (45.592%), while oleic acid was the major unsaturated fatty acid (37.189%). The oxidative stability (induction period/hrs) and the total phenolic content (mg GAE/g butter) of MSKB were 148.4 and 21.97, respectively. The effect of replacing shortening at levels of 25, 50 and 100 % by MSKB on the quality characteristics of batter and muffins was investigated. Muffin batter incorporated with 50% MSKB had the best viscosity being 16402.47 cp closed to that of the control (15373.46 cp) at the same shear rate of 16.2 S^{-1}. Measurements of tenderness (penetrometer) indicated that the replacement by 50% MSKB was significantly ($P > 0.05$) affected and the produced muffins were more tender than other muffin samples. The replacement by MSKB showed no extreme effects on weight loss and specific volume of muffins. As the replacing of MSKB increased, the colour of muffins crumb and crust were lighter than that of the control. Both samples contained 25% and 50% MSKB had lower values of a* (red component) than that of the control sample. The control muffins showed high purity (25.80) followed by muffin samples contained 50% MSKB (20.17) with total intensity 66.46 and 68.51, respectively. The highest content of total phenolic compounds and scavenging activity of muffins were appeared in 100% MSKB replacement muffins. Depending on sensory evaluation, the best ratio of replacing shortening by extracted MSKB was 50%.

***Keywords:** Mango seed kernels butter, muffins, antioxidant activity, phenolic content and physicochemical properties.*

INTRODUCTION

Mangos belong to the genus *Mangifera* of the family Anacardiaceae. The genus *Mangifera* contains several species that bear edible fruit. Most of the fruit trees that are commonly known as mangos belong to the species *Mangifera indica* (Nzikou *et al.*, 2010)

In Egypt, mango is the most popular fruits and is cultivated almost in the whole of the Nile valley and around the desert. There are several varieties grown in Egypt, the better known cultivars are Alphonso, Pairi, Zebda, Mabroka, Balady and Succary (El- Soukkary *et al* 2000). As with many fruits, the edible fleshly portion or pulp of mango fruit is relished to the extent of commercialization. A wide variety of processed products derived there from include canned whole or sliced mango pulp in brine or in syrup, mango juice, nectar, jam, sauce, chutney and pickle (Vandrendriessche, 1976).

Appreciable amounts of seeds could result as a waste from manufacturing of mango fruits, this may cause an ecological problem towards microbial contamination and pollution. Consequently, considerable amounts of edible oil could be obtained. El- Bastawesy *et al* (2007) revealed that, mango seed had high content of oil (21.85% on dry basis) and the chemical properties of this oil was in the normal range of edible oils.

Mohamed & Girgis (2005), reported that mango seed kernel oil can be utilized as a source of edible oil and they found that the fatty acids profile showed that stearic (27–46%) and oleic (40–48.3%) acids were the predominant fatty acids of the mango seed kernel fat, while palmitic, linoleic, linolenic, arachidonic and behenic acids were found in small amounts. Also, they found that, the total phenolic content of mango seed kernel was 72 mg/100 g.

Youssef, (1999) indicated that, adding 1% of crude oil extracted from mango seed kernel exhibited antioxidant potency similar to that of 200 ppm of BHT against oxidation of sunflower oil. Mango seed kernels are good source of polyphenols, phytosterols as campesterol, β– sitosterol and tocopherols (Soong *et al* 2004). The lipid composition of mango seed kernels has attracted the attention of scientists in recent years because of their unique physical and chemical characteristics. Rukmini & Vijayaraghavan (1984) found that the lipid consist of about 44– 48% saturated fatty acids (mainly stearic) and 52–56% unsaturated (mainly oleic). They also, reported that mango seed kernel fat is promising and a safe source of edible oil and was found to be nutritious and non– toxic so that, it could be substituted for any solid fat without adverse effects. Rashwan, (1990) showed that, lipids extracted from different mango varieties were free from toxic material such as hydrocyanic acid. Zein *et al* (2005), recommended that phenolic compounds and mango seed kernel crude oil both are considered as good natural antioxidants due to retarding oxidation in different edible oils. So, the mango seed kernel as a waste seems promising as a natural food additive for extending the shelf– life of a variety of food products.

Therefore, this work is aimed to investigate the physical and chemical properties, fatty acid composition and the stability of mango seed kernel butter (MSKB) and the effects of its implementation at different levels in muffins on the baking performance and quality attributes of the products.

MATERIALS AND METHODS

Materials

Mango seed kernels (Zebda variety) were collected after mango pulp processing from Al–Qahera Company for Agricultural Industry, Al–Obor, Egypt. Wheat flour (72% extraction), sugar, shortening, skim milk, baking powder, eggs and salt were purchased from the local market. Sodium carbonate, hexane and methanol were obtained from El–Gomhoreya Co., Cairo, Egypt. 1,1–diphenyl–2–picrylhydrazyl radical (DPPH) and Folin–Ciocalteu phenol reagent were purchased from Sigma–Aldrich Inc. (St Louis, MO, USA).

Preparation of mango seed kernel butter (MSKB):

The seeds were washed, air dried and the kernels were removed manually from the seeds. The kernels were chopped and dried at 50 °C over night (Augustin & Ling, 1987). The dried material was ground in a hammer mill into a powdery form. Hexane was added to the mango seed kernel powder at ratio of 2:1 (v/w) and kept overnight in dark with gentle shaking at 20°C, after removing the insoluble materials, the solvent was evaporated in a rotary evaporator at 30°C. The extracted butter was kept at −18°C until analysis and processing.

Chemical analysis of MSKB

Determination of total lipid content, melting point (°C), acidity % (as oleic acid), peroxide value (meq/kg), iodine value, and analysis of fatty acids using gas chromatography (GC Hewlett Packard 6890) were carried out in the extracted butter according to the methods described in the AOAC (2007). Total phenolic content of MSKB was determined according to Singleton *et al* (1999)

Determination of the oxidative stability of MSKB

The oxidative stability of butter was determined as induction period (hr) using Rancimat 679 apparatus (Metrohm Co., Switzerland) at 100°C with air flow rate 20 L/hr until the time taken reach to fixed level of conductivity according to the method reported by Tsakins *et al.*, (1999).

Muffins preparation:

Muffin formula contained the following ingredients: 34.05% wheat flour, 32.13% water, 15.42% sugar, 13.88% shortening, 2.57% skim milk powder, 1.29% baking powder, 0.45% egg and 0.13% salt (weight basis). Another three samples were prepared by replacing part of the shortening with mango seed kernels butter at ratios as follows: 25%, 50% and 100% according to Rupasinghe, *et al.*, (2008).

The wet ingredients were placed in the bowl of a Kitchen Aid type electrical mixer and whipped at speed 4 for 1 min. the sifted dry ingredients were then added and blended using the flat paddle at speed 1 for 4 sec before scraping the bowl and paddle. Batter samples (50 g) were weighed into each muffin cup and were baked at 204 °C for 22 min. Following a 5 min setting period, the muffins were removed from the cups and allowed to cool for 1 hr before being used in various sensory, physical and chemical tests.

Measurements and physical characteristics of batter and muffins

Apparent viscosity of the muffin batters were measured using the rotational viscometer (Rheotest, type RV2, Pruefgreat, Medingen, Germany).

The measuring investigated batter muffin samples were introduced into the device (H) of the cylinder viscometer and the viscosity was calculated according to Ibarz & Barbosa–Canovas, (2002)

Volume (cm^3) was measured using the rapeseed displacement method; specific volume and weight loss of muffin after baking were calculated according to the AACC (2000). The muffins were cut horizontally and images of the freshly cut surface of the crumb were captured using a digital camera (Nikon Coolpix S220, Japan).

Colour of muffins crumb and crust samples were determined according to the tristimulus colour system described by Francis (1983) using spectrophotometer (MOM, 100D, Hungary). Colour coordinates X, Y & Z were converted to corresponding Hunter L^*, a^* & b^* colour coordinates according to formula given by manufacturer. The chroma (C) represents colour saturation or purity was calculated from $C = (a^2+b^2)^{1/2}$ and the total colour intensity $(a^2+b^2+L^2)^{1/2}$.

For tenderness value, penetrometer number reading (Koehler Instrument Company, INC. Germany), was used. The average of three points for each muffin sample was recorded to give the compressibility in penetrometer units (P.U).

Antioxidant activity (scavenge activity %) of muffins

The ability of the methanolic extract of muffin samples to scavenge 1,1–diphenyl–2–picrylhydrazyl radical (DPPH) free radicals were determined by the method described by Blois (1958). Aliquots (200 μl) of each muffin sample extract were mixed with 1.0 ml of 0.1 mM DPPH in methanol. The control sample contained all the reagents except the extract. The reaction mixture was shaken well and allowed to react for 20 min at room temperature. The remaining DPPH free radicals were determined by absorbance measurement at 517 nm against methanol blank. The percentage scavenging effect was calculated from the decrease in absorbance against the control according to the following equation:

$$\text{Scavenging activity \%} = [(Abs_{control} - Abs_{sample})/Abs_{control}] \times 100$$

Determination of total phenolic content of muffins

The total phenolic content of methanolic extract of the muffin samples were determined colourimetrically, using the Folin–Ciocalteu method, as described by Singleton *et al* (1999). Aliquots of 0.5 ml of the extract were added to 0.5 ml of Folin–Ciocalteu reagent, followed by addition of 0.5 ml of an aqueous 7.5% solution of sodium carbonate. The mixture was stirred and allowed to stand for 30 min. The absorbance at 765 nm was measured using a model UV/VIS 1201 spectrophotometer (Shimadzu, Kyoto, Japan). A blank sample consisting of water and reagents was used as a reference. The results were expressed as milligrams of gallic acid equivalents per gram muffin samples (mg GAE/g) reference to the gallic acid calibration curve.

Sensory evaluation of muffins

The muffins incorporated with mango butter were introduced to sensory evaluation by ten member semi trained panels of Food Science Department Staff. The panelists were asked to score each sensory attribute using the control muffins as basic for evaluation. The muffins were evaluated for appearance, crust colour, crumb colour, grain, tenderness, moistness, flavour, mouthfeel and overall quality on a 9–point hedonic scale using a report sheet according to Johnson (1990).

Statistical analysis

All data were expressed as mean values ± SD. Statistical analysis was performed using one way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test with $P \geq 0.05$ being considered statistically significant using SAS program (SAS, 1996).

RESULTS AND DISCUSSION

Physicochemical properties of extracted mango seed kernel butter (MSKB)

Melting point, acidity (as oleic acid %), peroxide and iodine values of MSKB were determined and tabulated in Table (1). It could be noticed that the melting point of MSKB was 32°C. Moreover, MSKB had a relatively low acidity (0.76 %) indicating that the mango seed butter was just about free from hydrolytic rancidity brought almost by lipases and enables the direct use of such oil in industries without further neutralization as described by Arogba, (1997) and Saiprabha & Goswami–Giri (2011). On the other hand, MSKB had good quality due to the low level of the peroxide value (2.78). The iodine value of MSKB was 55.15, therefore MSKB could be considered as a non drying oil.

This value is close to the values reported by Mohamed & Girgis (2005).

Table 1: Some physical and chemical properties of MSKB

Properties	Values
Melting point (°C)	32
Acidity (as oleic acid %)	0.76
Peroxide value (meq/kg)	2.78
Iodine value	55.15

Fatty acids composition

The fatty acid composition of MSKB is presented in Table (2). The results revealed that the studied butter contained a considerable amount of total saturated fatty acid being 56.748 % and the ratio of unsaturated to saturated fatty acids was 0.76. This ratio indicated that MSKB is highly stable to oxidation as mentioned by Hemavathy *et al* (1987). Stearic acid was the main saturated fatty acid, while oleic acid was the major unsaturated one. On the other hand, linolenic acid was found in less amount as well as C22:0. Accordingly, MSKB is more stable than many other vegetable oils rich in polyunsaturated fatty acids. Such butter seemed to be suitable for blending with vegetable oils, stearin manufacturing, confectionery and in the soap industries. These results confirmed those of Abdalla *et al* (2007) and Nzikou *et al* (2010).

Table 2: Relative percentage of fatty acid composition of extracted MSKB

Fatty acids	%
C16:0	7.83
C18:0	45.59
C18:1	37.19
C18:2	5.48
C18:3	0.40
C20:0	2.48
C20:1	0.18
C22:0	0.45
C24:0	0.40
Total saturated fatty acids (TSFA)	56.75
Total unsaturated fatty acids (TUSFA)	43.25
Total fatty acids	100

Oxidative stability and total phenolic content

Lipid oxidation is one of the major deteriorative reactions especially, in highly fat processed foods such as margarines, butters and other products. So, it is important to predict the oxidative stability of the given fat by rapid and reliable methods in order to determine the shelf life and to evaluate the effect of protective antioxidants. From the data presented in Table (3), it could be easily to notice that the mango seed kernel butter had high oxidative stability reached to 148.4 hr. at 100 °C due to its fatty acids pattern which is rich in saturated fatty acids and mono–unsaturated oleic acid as mentioned by Abdalla *et al* (2007).

From the data in Table (3), mango seed kernel butter was found to be a good source of total phenolic content besides, its great resistance to oxidation which may be due to its rich content of phytochemicals that play a great role to protect human body and enabling the butter to be used in food industries. It is also useful for blending with less stable oils, and using in cooking and deep frying. These results are parallel to Pitchaon (2008)

Table 3: Oxidative stability and total phenolic content of MSKB

Parameters	Values
Oxidative stability (induction period, hrs)	148.4
Total phenolic content (mg GAE*/g butter)	21.97

* GAE: gallic acid equivalents

Apparent viscosity of muffin batter incorporated with different levels of MSKB

The relationship between apparent viscosity and shear rate (Fig. 1) showed that a curve, which confirms the behaviour of non–Newtonian fluid. All muffins batter samples showed high viscosity at the lowest shear rate (0.33 S^{-1}) followed by a rapid decrease in their viscosity to the shear rate of 9 S^{-1} and then they had behaviour of Newtonian fluid in the form of a straight line starting from the high shear rate of 48 S^{-1}. These trends are in harmony to those obtained by Baixauli *et al.* (2008)

When studying the effect of mango seed kernel butter (MSKB) added to muffins batter at different levels, it was noticed that muffin batter incorporated with 25% MSKB revealed an increase in the viscosity being 26129.63 cp as compared to that of the control which was 15373.46 cp at the same shear rate of 16.2 S^{-1}. Also, muffin batter contained 100% MSKB gave the same trend of that contained 25% MSKB as compared to the control batter at the same shear rate of 16.2 S^{-1}. Whereas,

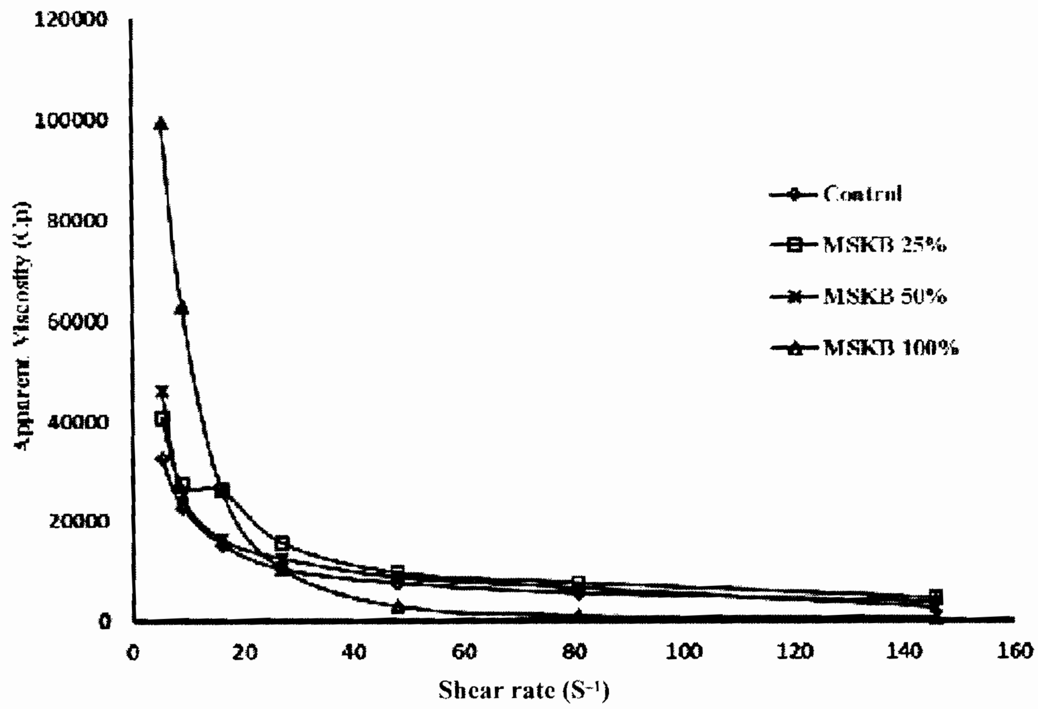


Fig. 1: Influence of MKSB (Mango seed kernel butter) replacement's on apparent viscosity of muffins

the batter of muffin incorporated with 50% MSKB occurred the best viscosity (16402.47 cp) closed to that of the control batter at the same shear rate of 16.2 S^{-1}. These results showed that the increase in the viscosity of batter contained different amounts of MSKB resulted in a high quality of the final product as compared to the control. High quality of muffin batter is mainly associated with an increase in retaining air bubbles and high volume of muffins as mentioned by Lakshminarayan *et al.* (2006).

Quality characteristics of muffins containing mango seed kernel butter

From the results in Table (4), there were significant ($P \geq 0.05$) differences among muffins contained different amounts of MSKB and the control in their measurements and physical characteristics. The replacements by 25% &100% of MSKF showed a similar significant ($P \geq 0.05$) effect on the tenderness of the produced muffins measured by penetrometer and did not differ from the control. Meanwhile, the replacement by 50% MSKF significantly ($P \geq 0.05$) affected this parameter and the produced muffin was more tender than the others.

From the data in Table (4), the results of weight loss and specific volume of different muffins showed that there were slight significant ($P \geq 0.05$) differences between the control and the other muffins contained MSKB at different ratios. So, it could be concluded that the replacement by MSKB did not have an extremely affect on these parameters.

Colour of muffins

Colour as a matter of visual perception is an important consideration in food product development because food colour and appearance are usually the first impressions to register in the consumer

Table 4: Some physical characteristics of muffins containing MSKB*

Treatment	Penetrometer (P.U.)	Weight loss (g)	Volume (cm^3)	Specific volume (cm^3/g)
Control	16.67±0.29^b	11.02±0.37^a	94.00±1.00^b	1.89±0.01^b
MSKB 25 %	17.67±0.58^b	9.59±1.13^b	104.33±6.03^a	2.09±0.02^a
50 %	22.17±1.53^a	10.18±0.25^{ab}	105.67±0.58^a	2.11±0.01^a
100 %	17.67±0.76^b	11.07±0.44^a	104.00±2.00^a	2.08±0.01^a

* Mango seed kernel butter.
Data are the mean ± SD, n = 3, Mean values in the same column bearing the same superscript do not differ significantly ($P \geq 0.05$).

mind. Analysis of muffins for (L*) lightness, (a*) redness and (b*) yellowness as well as chroma and total intensity characteristics are shown in Table (5). It is clear that the muffins contained MSKB had lighter crust colour more than that of the control sample. When the batter was incorporated with 25% MSKB, the obtained muffin showed significantly ($P \geq 0.05$) the lightest crust colour and total intensity as compared to the other samples. On the other hand, the control sample recorded the highest value of a* (red component) while the highest values of yellowness & purity were appeared in muffins containing 50% MSKB being 30.34 and 32.26, respectively.

Concerning crumb colour, it could be noticed that as the replacing by MKSB increased the muffins crumb were significantly lighter than that of the control sample. Both samples containing 25% & 50% MSKB had significantly lower values of a* (red component) than the control sample, meanwhile, replacing by 100% MSKB showed an opposite trend, it showed the highest crumb value. The highest yellowness of muffin crumb was appeared in the control sample, followed by muffins contained 50% MSKB then 25% MSKB and finally 100% MSKB. The control muffins showed the highest purity of crumb (25.80) followed by the samples contained 50% MSKB (20.17). It was noticed that the total intensity of crumb colour was significantly increased with raising the replacement level by MSKB in muffins batter as compared to that of the control which showed the least value.

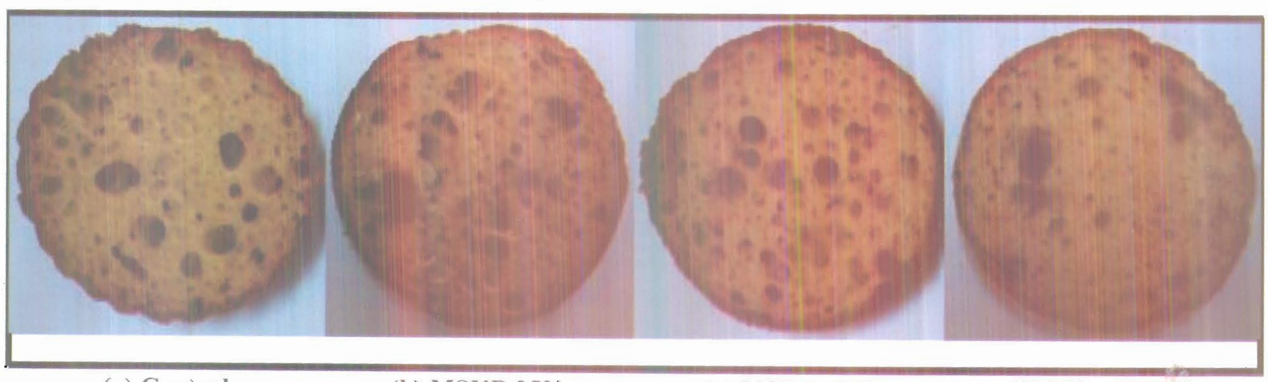
Appearance of muffin:

As shown in (Fig. 2) it could be noticed that as the amount of MSKB increased, the crumb grain became more compact especially at the level of 100% MSKB. On the other hand, the structure of muffin crumb baked from batters contained 50% MSKB was more similar to that of the control than the other replacement levels, this structure is associated with a softer and lighter crumb.

Table 5: Mean colour values for the crust and crumb of muffins contained different amounts of MSKB (Mango seed kernel butter)

Treatment	L*	a*	b*	Chroma	Total Intensity
Crust colour					
Control	45.49±0.03^{d}	14.19±0.09^{a}	26.14±0.08^{c}	29.74±0.1^{b}	54.35±0.03^{d}
MSKB 25%	63.21±0.02^{a}	3.24±0.14^{c}	27.82±1.03^{b}	28.01±1.0^{c}	69.14±0.39^{a}
50%	57.42±0.02^{c}	10.94±0.42^{b}	30.34±0.05^{a}	32.26±0.18^{a}	65.86±0.1^{c}
100%	62.69±0.01^{b}	2.73±0.17^{d}	24.81±0.05^{d}	24.96±0.04^{d}	67.48±0.02^{b}
Crumb colour					
Control	61.25±0.01^{d}	1.71±0.08^{b}	25.74±0.09^{a}	25.80±0.08^{a}	66.46±0.02^{d}
MSKB 25%	64.33±0.01^{c}	0.45±0.11^{c}	19.37±0.07^{c}	19.37±0.06^{c}	67.19±0.01^{c}
50%	65.47±0.01^{b}	0.11±0.05^{d}	20.17±0.09^{b}	20.17±0.09^{b}	68.51±0.02^{b}
100%	68.90±0.04^{a}	2.38±0.03^{a}	19.04±0.06^{d}	19.19±0.06^{d}	71.52±0.02^{a}

Data are the mean ± SD, n = 6, Mean values in the same column bearing the same superscript do not differ significantly ($P \geq 0.05$). L*, lightness; a*, redness; b*, yellowness.



(a) Control (b) MSKB 25% (c) MSKB 50% (d) MSKB 100%

Fig. 2: Internal appearance of muffins containing different levels of MSKB (Mango seed kernel butter)

Total phenolic content & scavenging activity of muffins

The results of total phenolic content and scavenging activity of muffins contained different levels of MSKB were presented in Table (6). From these results, it could be found that as the replacing level by MSKB increased, the total phenolic content and scavenging activity of muffins increased. The highest content of total phenolic content and scavenging activity of muffins were appeared in 100% MSKB muffins. Also, it could be easily noticed that there was a significant ($P \geq 0.05$) positive relationship between phenolic content and scavenging activity. It means that increasing the MSKB levels in muffins raised the oxidative stability. These results coincide with those of Puravankara *et al.* (2000).

Table 6: Total phenolic content and scavenging activity of muffins contained different levels of MSKB

Treatment	Total phenolic (mg GAE/g)	Scavenging activity %
Control	1.38 ± 0.15[d]	1.13 ± 0.19[d]
MSKB 25%	13.08 ± 0.53[c]	5.14 ± 0.09[c]
MSKB 50%	19.44 ± 0.33[b]	9.72 ± 0.18[b]
MSKB 100%	21.23 ± 0.39[a]	12.59 ± 0.05[a]

Data are the mean ± SD, n = 3, Mean values in the same column bearing the same superscript do not differ significantly ($P \geq 0.05$).

Sensory evaluation of muffins:

The data in Table (7) represent the mean scores of appearance, crust colour, crumb colour, grain, tenderness, moistness, flavour, mouthfeel and overall quality of prepared muffins contained different levels of MSKB. The results show that, there were no significant ($P \geq 0.05$) differences between the control muffins, and the muffins made from batter containing of 50% MSKB, they received significantly the highest score values in all quality attributes. Muffins with replacement levels of 25% MSKB also did not show significant ($P \geq 0.05$) difference, as compared to the control and 50% MSKB muffins except in tenderness, flavour and overall quality characteristics. Meanwhile, the scores of muffin containing 100% MSKB fell in almost sensory attributes as a result of high replacement level.

The obtained results indicated that mango seed kernel butter (MSKB) could be considered as an encouraging option for replacing shortening in muffin formulation up to 50% depending on its sensory characteristics.

CONCLUSION

Based on the results obtained here, it could be concluded that the mango seed kernel butter (MSKB) could be used as a potential source for functional food ingredients in bakery products due to its content of some phytochemicals. The best replacement of MSKB in muffins preparation was 50% based on its sensory attributes.

Table 7: Sensory attributes of muffins incorporated with different levels of MSKB

Attributes	Control	MSKB		
		25%	50%	100%
Appearance	8.67 ± 0.52[a]	8.17 ± 0.75[a]	8.50 ± 0.55[a]	7.00 ± 0.63[b]
Crust colour	8.00 ± 0.63[a]	7.67 ± 0.52[a]	7.83 ± 0.41[a]	7.33 ± 0.52[a]
Crumb colour	8.17 ± 0.98[a]	8.00 ± 0.52[a]	7.80 ± 0.75[a]	6.00 ± 0.89[b]
Grain	8.00 ± 1.26[a]	7.50 ± 1.05[a]	7.90 ± 1.03[a]	6.17 ± 0.98[b]
Tenderness	8.00 ± 1.26[a]	6.50 ± 1.05[b]	7.00 ± 1.55[a]	6.33 ± 1.37[b]
Moistness	7.83 ± 1.47[a]	7.50 ± 0.55[a]	7.67 ± 1.37[a]	6.67 ± 1.37[b]
Flavour	8.17 ± 0.75[a]	7.50 ± 1.22[b]	8.00 ± 1.1[a]	4.67 ± 0.82[c]
Mouthfeel	7.83 ± 1.47[a]	8.50 ± 0.55[a]	7.50 ± 0.84[a]	4.50 ± 0.84[b]
Overall quality	8.17 ± 1.33[a]	7.67 ± 0.52[ab]	8.33 ± 1.86[a]	6.33 ± 0.82[c]

Data are the mean ± SD, n = 10, Mean values in the same raw bearing the same superscript do not differ significantly ($P \geq 0.05$).

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صفات زبد نواة بذور المانجو وتأثيرها على خصائص جودة فطائر القوالب «المافين»

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تم تجميع بذور المانجو المصرية (صنف الزبدية) من أحد المصانع المحلية لتصنيع الفاكهة. تم فصل القشور يدويا ثم جففت البذور علي درجة حرارة ٥٠ مئوي طوال الليل ثم تم إستخلاص الزبد من البذور وتقدير الخصائص المختلفة للزبد المستخلص. أوضحت النتائج احتواء بذور المانجو علي كمية من الزبد تقدر بحوالي ٢١٪. كما اتصف الزبد المستخلص من البذور بالخصائص التالية، نقطة انصهار ٣٢ درجة مئوية، حموضة مقدرة كنسبة مئوية كحمض الأوليك ٠,٧٦٪ ورقم بيروكسيد ٢,٧٨٢ ملمكافئ/كجم، ورقم يودي ٥٥,١٥. وتوضح هذه النتائج أن خصائص زبد بذور المانجو المستخلص تقع في نفس المدي للزيوت الغذائية. عند تقدير الأحماض الدهنية لزبد بذور المانجو اتضح أن حمض الإستياريك هو الحمض السائد (٤٥,٥٩٪) في حين شَكَلَ حمض الأوليك النسبة الكبري من الأحماض الدهنية غير المشبعة (٣٧,١٩٪). كان الثبات ضد الأكسدة وكذلك المحتوي من الفينولات لزبد بذور المانجو المستخلص على النحو التالي: ١٤٨,٤ ساعة و٢١,٩٧ علي الترتيب. تم استخدام زبد بذور المانجو المستخلص كبديل للدهون المقصرة عند صناعة المافين وأوضحت النتائج أن عجينة المافين المنتجة باستبدال الدهون المقصرة بزبد بذور المانجو بنسبة ٥٠٪ أعطت قيم لزوجة مقاربة للعينة المرجعية المحتوية علي ١٠٠٪ دهون مقصرة، وأظهرت عينات المافين المنتجة باستبدال الدهون المقصرة بزبد بذور المانجو بنسبة ٥٠٪ طراوة (مقدرة بجهاز قياس مسافة الاختراق «البنتروميتر») بالمقارنة بباقي العينات المنتجة. كما لم يؤثر بوضوح استبدال الدهون المقصرة عند إنتاج المافين بزبد بذور المانجو هي علي فقد الوزن والحجم النوعي بالمقارنة بالعينة المرجعية. وانعكس ذلك علي خصائص اللون لعينات المافين المنتجة. وكانت عينات المافين المحتوية علي ١٠٠٪ من زبد بذور المانجو هي الأعلى في محتواها من المركبات الفينولية الكلية والنشاط ضد الأكسدة. بناءً علي نتائج التقييم الحسي لعينات المافين المنتجة قدرت ٥٠٪ من زبد بذور المانجو كأفضل نسبة استبدال للدهون المقصرة دون تأثير سلبي علي العينات المنتجة.