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Using of Mango (*Mangifera indica L.*) Kernel Powder as Partial Replacer of Wheat Flour in Cupcake Producing

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ABSTRACT

The primary goal of this research was using of mango kernel powder as partial replacer of wheat flour in making cupcakes with the following replacing levels; 0, 10, 20, 30, and 40% and studding the effect of this replacing on the physical, chemical, rheological and sensory characteristics of wheat flour, wheat flour /mango kernel mixtures and the produced cupcakes. The results showed that mango kernel powder (variety: El-Gahrawy) has the following chemical composition: 9.42, 6.36, 12, 2.09, 4.38, and 65.75% for moisture, protein, fat, ash, and carbohydrates, respectively. The organoleptic characteristics of cupcake samples indicated that the replacing of wheat flour with mango kernel powder had a significant impact on the product approval. The final ratings showed that C_1 (10%) was exceedingly well-liked and was on par with the control sample (C_0). Based on color properties, it can be observed that the lightness (L*) of cupcake samples is decreased with increasing the replacement level. Also, the results exhibited that the replacing of wheat flour with mango cupcake resulted in an increment in moisture, fat, fiber, and ash of cupcake samples. Finally, the replacing of wheat flour with mango kernel powder up to 30 % result in improving nutritional profile and sensory parameters.

INTRODUCTION

Mango (*Mangifera indica L.*) is an important tropical fruit crop which is grown primarily for its edible fruit. The origin of mangoes is in South Asia. **(Lawson *et al.*, 2019**). Mango fruit is consumed all over the world for its juiciness, wonderful taste, unique flavor, and nutritious benefits Such as vitamins A, C, B2, B3, and B9, and fiber. About 20% of mango fruits, are processed to make products like puree, nectar, pickles, jams, jellies, canned slices, frozen mango, and dried products **(Lauricella *et al.*, 2017)**.

Mango fruits are commonly available fruit in marketplaces, which has the potential to bring in significant amounts of foreign exchange **(Reddy *et al.*, 2021).** The edible portions of the mango tree, such as its leaves, bark, blossoms, fruit, peels, and seeds, are packed with useful nutrients. Peels and seeds of mangos are regarded as substantial by-products of mango processing. The seeds (kernels) of mango represent approximately 35–40% of the fruit's weight. are disposed of as solid waste in the processing sector after pulp fruit is extracted. **(Mutua *et al.*, 2017)**. The kernels of mango seeds are a good source of several nutrients. As, each 100 grams of mango seed kernel powder contain 6.36 g protein, 13 g fat, 32.24 g carbohydrates, 0.19 g vitamin B-6, 1.3 mg vitamin E, 2.02 g dietary fiber, 22.34 mg magnesium and 0.12µg vitamin B12. In addition, each 100 g of mango kernel powder contain many amino acids; leucine (8.4g), isoleucine (3.23g), histidine (2.31g), valine (3.8g), threonine (2.04g), and lysine (3.13g) **(Dakare *et al.*, 2012).** The main constituents of mango kernels are protein, fat, and starch. About 44–88% of mango kernels oil is made up of saturated fatty acids, which considered high quality lipids makes it a good source for

functional food ingredients, animal feed, and cosmetics. **(Torres-León *et al*., 2016).**

Cupcakes are a popular snack in most parts of the world. Its ingredients include wheat flour, butter, and sugar; baking powder is typically added to lighten it **(Topkaya and Isik, 2019).** Wheat flour is the primary ingredient in cupcake products due to its gluten proteins that aren't found in other cereals' flour, since baking and gluten gives the dough its elastic texture and improve sensory traits **(Isik *et al*., 2017).** Cupcakes are made using wheat flour, which is deficient in lysine and fiber, so mango kernel powder (which is rich in protein, vitamins, and phytochemicals) has been demonstrated to be a viable ingredient for cupcake recipes which is raising the protein content and nutritional value of cupcakes. Thus, this study was aimed to assess the effect of mango kernel powder addition as partial replacer for wheat flour on the physiochemical, rheological, and organoleptic acceptability of cupcakes.

MATERIALS AND METHODS

Materials

Mango fruit:

Magnifera indica, variety El-Gahrawy, was obtained from a farm in Damietta City during the 2021–2022 season.

Other materials:

Cupcake ingredients; wheat flour (72% extraction), eggs, sugar, salt, milk powder, butter and vanilla essence were bought from the local market of Damietta, Egypt.

Methods:

Preparation of kernel powder:

Mango seeds were cleaned from foreign materials, then the kernels were manually separated, then sun-dried for eight hours for reducing the moisture content. Mango kernel powder was prepared as follows: the kernels were sectioned into small pieces and then dried in a 50°C oven until they reached a constant weight. Finally, mango kernels were ground using an electric blender (Lab Scale Mill)**,** sieved and stored in sealed jars **(Chen *et al*., 1998).**

Preparation of cupcake with using mango kernel powder as partial replacer of wheat flour:

Cupcake was formulated to contain mango kernel powder as partial replacer of wheat flour with the following replacing levels; 0, 10, 20, 30 and 40 % as showed in Table A as follows: Each ingredient was weighed individually and combined in a basin. Cupcake was prepared by weighing and placing the egg in the bowl then it was beaten until foam appeared. The butter and sugar were added to the beaten egg and blended thoroughly. Subsequently, the wheat flour or wheat flour/mango kernel powder mixture, baking powder, milk powder, and salt were added and thoroughly combined using a spoon to create the correct combination then vanilla essence was added to the mixture and beaten one more time. The mixture was baked in cupcake cups at 160°C for 40 minutes **(Akter and Alim, 2018).**

Table A: Formulation of mango kernel flour cupcake recipe:

Ingredient (g)	Treatment*				
	C_0	C_1	C_2	C_3	C_4
Wheat flour	100	90	80	70	60
Mango kernel powder	--	10	20	30	40
Egg	110	110	110	110	110
Sugar	85	85	85	85	85
Salt	2	2	2	2	2
Milk powder	25	25	25	25	25
Baking powder	4	4	4	4	4
Butter)	70	70	70	70	70
Vanilla essence (drops)	2	2	2	2	2

*** C0: control sample;**
C1: cupcakes with kernel powder 10%;
C2: cupcakes with kernel powder 20%;
C3: cupcakes with kernel powder 30%;
C4: cupcakes with kernel powder 40%.

Analytical methods:

Chemical composition; Moisture (dry oven method), protein (Kjeldal method), crude fat (Soxhlet method), fiber (gravimetric method), and crude ash (method of muffle furnace) of mango kernel powder, wheat flour, and cupcake samples were determined according to the method of **AOAC (2016),** while carbohydrates content was calculated by differences. The caloric value was calculated according to the method of **Joint F.A.O./W.H.O. (1971)** by using the following equation:

Caloric value = Fat (g)×9 +Protein (g) ×4 + Carbohydrates (g) ×4

Determination of minerals of wheat flour and mango kernel flour: Potassium, Phosphorus, Calcium, magnesium, Fe and Zn contents were determined using Perkin-Elmer Atomic Absorption Spectrophotometer 2380 as described in **AOAC (2016)** at Faculty of Science, Damietta University.

Evaluation of Cupcake Quality:

Physical characteristics of cupcakes:

The weight of cupcakes was assessed after one hour of chilling. The volume was determined according to **(AACC, 2010).** To calculate the specific volume, volume (cm^3) was divide by weight (g).

Color measurements of Cupcakes:

The color of samples was determined instrumentally, the (L*a*b*) by a colorimeter **(Konica Minolta CM3600A, Osaka, Japan) (CIE, 2004).**

Color was measured in three units: L* "lightness", a* "redness", and b* "yellowness". Cupcake samples were placed immediately below the colorimeter's aperture and measured on three sides each for color analysis.

Sensory evaluation:

Cupcakes were sensorial evaluated by 10 panelists. The sensory attributes were evaluated by the panelists with using the following scale; 1 (very dislike), 2- 4 (dislike, 5-6 (fair), 7-8 like, and 9-10 (highly like). Sensory evaluation was carried out under the guidance of the Food-Industries Department at Damietta University, Egypt **(Mahmoud *et al*., 2021).**

Rheological characteristics of wheat flour and wheat flour /mango kernel powder:

Farinograph:

Farinograph parameters of dough prepared with wheat flour or wheat flour /mango kernel powder were evaluated by farinograph in accordance with **(AACC, 2010).**

Extensograph:

Extensograph parameters of dough prepared with wheat flour or wheat flour /mango kernel powder were examined by extensograph, as described by **AACC (2010).**

RESULTS AND DISSCUSSION

Chemical composition of wheat flour and mango kerenel powder:

Table 1 shows the chemical composition of wheat flour and mango kernel powder. The data demonstrated that mango kernel powder had significantly higher content of fat, ash, and fiber than wheat flour. While wheat flour was had higher moisture, protein, and carbohydrate contents than that of mango kernel powder. The high fat content of mango kernel powder was reflected in a significant higher caloric value than wheat flour.

The carbohydrate level in mango kernel flour indicates that mango kernel could be used as an energy source. These results are consistent with the results obtained by **(Fowomola, 2010)** with slight differences; these differences might be due to the different variety and environmental factors **(Thenabadu and Seneviratne, 2022).**

Table 1: Chemical composition of wheat flour and mango kernel powder (based on wet weight):

Parameters	Wheat flour	Mango kernel powder	LSD at 5%
Moisture (%)	12.40^a	9.42^b	1.93
Protein (%)	12.58^a	6.36^b	2.35
Fat (%)	1.02^a	12^b	0.77
Ash (%)	0.61^b	2.09^a	0.334
Crude Fiber (%)	0.88^a	4.38^b	1.93
Carbohydrates (%)	72.51^a	65.75^b	0.711
Calories / 100g	349.54^b	396.44^a	0.309

-Means in the same row with the same superscript are not significantly different at (p <0.05).

Minerals content of mango kernel powder and wheat powder:

The results tabulated in Table 2 showed the mineral content (mg/100g) of wheat flour (72% extraction) and mango kernel powder on dry weight basis. it could be noticed that there were significantly differences in minerals composition between mango kernel powder and wheat flour.

Table 2: Minerals content of mango kernel flour and wheat flour (mg/100 g dry weight):

Mineral mg/100 g	Wheat flour (72%)	Mango Kernel powder	LSD at 5%
K	154.00^b	863.70^a	0.47
P	2.22^b	91.20^a	4.08
Ca	12.03^b	16.76^a	1.67
Mg	40.34^b	88.33^a	0.91
Fe	3.14^b	19.52^a	3.34
Zn	1.85^b	9.40^a	4.08

Means in the same row with the same superscript are not significantly different at (p <0.05).

The mango kernel powder contained higher amounts of potassium, phosphorus, calcium, magnesium, iron, and zinc than wheat flour, which recorded 863.70 and 154.00 for potassium, 91.20 and 2.22 for phosphorus, 16.76 and 12.03 for calcium, 88.33 and 40.34 for magnesium, 19.52 and 3.14 for iron and 9.40 and 1.85 mg/100 g for zinc, respectively. So kernel powder could be used to enhance the mineral content of the prepared product. These results were close to the results obtained by **(Kaur and Brar, 2017), (Gumte *et al*., 2018) and (Faten *et al*., (2018)**, who revealed that mango kernel powder had significantly higher content of minerals than wheat flour.

Chemical composition of cupcake samples:

The chemical composition of food items reveals information about the product's nutrients content. Table 3 shows the approximate chemical composition of cupcakes prepared with using mango kernel powder as partial replacer of wheat flour as compared to control sample (prepared wheat flour).

Table 3: Approximate chemical composition of cupcake samples:

Parameter (%)	Treatments*					LSD
	C_0	C_1	C_2	C_3	C_4	
Moisture	14.17^{a}	15.02^{ab}	15.61^{ab}	15.71^{a}	16.03^{a}	1.54
Protein	7.24^{a}	7.18^{a}	7.06^{a}	6.85^{a}	6.67^{a}	2.18
Fat	18.32^{c}	18.67^{c}	19.18^{bc}	20.04^{ab}	20.85^{a}	1.36
Ash	2.02^{b}	2.21^{b}	2.54^{b}	2.73^{b}	2.88^{a}	4.08
Fiber	0.85^{b}	7.04^{a}	8.11^{a}	8.24^{a}	8.40^{b}	5.78
Carbohydrates	57.40^{a}	49.88^{b}	47.5^{c}	46.43^{d}	45.17^{e}	0.86
Calorie/100 g	423.44^{a}	396.27^{b}	390.86^{c}	393.48^{d}	395.01^{e}	0.29

Means in the same row with the same superscript are not significantly different at (p <0.05).
***C0: control sample;**
C1: cupcakes with kernel powder 10%;
C2: cupcakes with kernel powder 20%;
C3: cupcakes with kernel powder 30%;
C4: cupcakes with kernel powder 40%.

There was a gradual increase in moisture, fat, ash and fiber content, where it ranged from (14.17-16.03) %, (18.32-20.85) %, (2.02-2.88) % and (o.85-8.40) %, respectively for moisture, fat, ash and fiber content with the increase of replacing level of wheat flour with mango kernel powder. On the other hand, there was a gradual decrease in the protein and carbohydrate contents of cupcake samples with the increase of mango kernel powder. The increase in moisture content of cupcake samples might be due to the increase in fiber, as the fiber holds more water. These results are in the same trend with that reported by **(Das et al., 2019)** who found that samples comprised approximately 13.73-15.48% moisture, 6.92-7.37% protein, 22.42-24.45% fat, 1.92-2.20% ash, and 52.70-52.81% carbohydrate.

Physical characteristics of cupcakes:

Table 4 shows the changes in physical characteristics of cupcakes formulated with wheat flour or wheat flour / mango kernel powder. The results exhibited that the weight of cupcake samples is gradually increased as the replacing level of wheat flour with mango kernel powder is increased, but there were no significant differences among them. The rise in cupcake weight could be attributed to the increase in fiber content, which result in increasing the water binding capacity, as reported by **(Sudhakar and Maini, 2000 and Chaplin, 2003).**

Table 4: Physical characteristics of Cupcakes:

Sample	Weight	Volume	Specific volume
C_0	24.12^{a}	85.44^{a}	3.54^{a}
C_1	24.33^{a}	81.60^{b}	3.35^{a}
C_2	24.86^{a}	77.51^{c}	3.12^{a}
C_3	25.08^{a}	73.18^{d}	2.99^{a}
C_4	25.26^{a}	69.62^{e}	2.76^{a}
LSD at 5%	1.18	0.69	0.308

Mean values in the same column with the same letter are not significantly different at (p <0.05).
Note: C0: control sample;
C1: cupcakes with kernel powder 10%;
C2: cupcakes with kernel powder 20%;
C3: cupcakes with kernel powder 30%;
C4: cupcakes with kernel powder 40%.

On the other side, the results demonstrated that the volume of cupcake samples is significantly decreased as substitution level of wheat flour with mango kernel powder is increased, since the cupcake sample formulated with replacing 40 % of wheat flour with mango kernel powder (C_4) recorded the lowest volume (69.62 cm^3) as compared to control sample which recorded the highest volume (85.44 cm^3). Regarding, the specific volume of cupcake samples, the data shows that it is decreased as the wheat flour substitution with mango kernel powder is increased, where the lowest specific value was noticed for cupcake sample that containing 40 % of mango kernel powder (C_4) as compared to control (C_0).

These findings are consistent with those reported by **Faten *et al.* (2018),** who revealed that the addition of mango kernel powder was resulted in increasing the weight and decreasing the volume and specific volume of cupcake samples.

Color measurements of cupcake samples:

One of the most crucial aspects of cupcakes for consumer acceptance is color. So, it is important to notice how the color changes during product development. Table 5 shows the effect of replacing wheat flour with mango kernel powder (up to 40 %) on the color characteristics of cupcake samples.

Table 5: Color measurements of Cupcake Samples:

Sample	Color characteristics		
	L*	a*	b*
C_0	43.72^a	9.01^a	28.47^a
C_1	42.46^b	11.64^b	24.40^b
C_2	42.38^b	11.90^b	23.97^b
C_3	38.40^c	14.02^c	23.39^b
C_4	36.02^d	17.33^d	21.42^c
LSD at 5%	0.96	1.92	1.26

Mean values in the same column with the same letter are not significantly different at (p <0.05).

Note: C0: control sample;
C1: cupcakes with kernel powder 10%;
C2: cupcakes with kernel powder 20%;
C3: cupcakes with kernel powder 30%;
C4: cupcakes with kernel powder 40%.

The results revealed that substituting of wheat flour with mango kernel powder was decreased the L*value (Lightness) of cupcake samples gradually with increasing the level of substitution. The lowest L*value was reported for cupcake sample that containing 40 % of mango kernel powder (C_4) (36.02) as compared to the control sample which recorded the highest L*value (43.72). In contrary, the increase of substitution level led to an increment in the a* value (redness), since the highest a*value was recorded for cupcake sample that fabricated with replacing 40 % of wheat flour with mango kernel powder (17.33) whereas the lowest a*value was recorded for control sample (9.01). The b* values (yellowness) followed the same trend as the L* values, as it decreased with increasing the replacement level of wheat flour with mango kernel powder, where the lowest b* value was noticed for C_4 cupcake sample that fabricated with replacing of 40 % of wheat flour with mango kernel powder (21.42) while the highest b* value was recorded for control sample (28.47). These results were in agreement with that obtained by **Thenabadu and Seneviratne (2022)**. who reported that the L* value and b* value were decreased by the increase of mango kernel powder in muffins formula, but it caused an increment in the a* value.

Sensory evaluation of cupcakes:

Cupcake samples were produced using the conventional process, with varying degrees of mango kernel flour added at amounts of 0, 10, 20, 30, and 40%. Table 6 and Figure 1 show the effects of replacing wheat flour with mango kernel flour (up to 40%) on the sensory quality of cupcakes.

Table 6: sensory evaluation of cupcakes:

Sample	Properties				
	color (10)	Flavor (10)	Taste (10)	Texture (10)	overall acceptability (10)
C_0	8.5^a	8.5^a	8.5^a	8.5^a	8.5^a
C_1	7.5^{ab}	8^a	7.5^a	7.5^a	7^{ab}
C_2	6.5^{abc}	7.5^a	7^a	7^a	6.5^{bc}
C_3	6^{bc}	7^a	7^a	6.5^a	6^{abc}
C_4	4^c	4^b	3^b	3^b	4^c

- Mean values in the same column with the same letters are not significantly different at (p <0.05).

Note: C0: control sample;
C1: cupcakes with kernel powder 10%;
C2: cupcakes with kernel powder 20%;
C3: cupcakes with kernel powder 30%;
C4: cupcakes with kernel powder 40%.

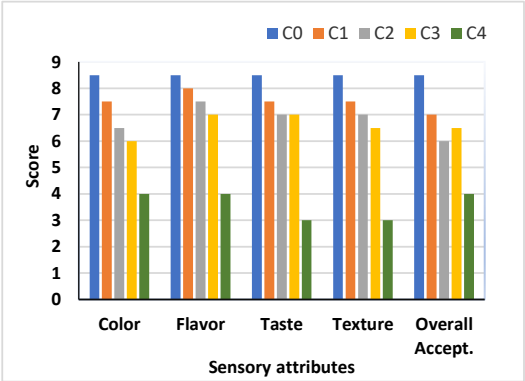

Figure 1: The impact of replacing wheat powder with mango kernel powder on sensory attributes.

Previous research found that replacing of wheat flour with mango kernel powder to the cupcake recipe significantly increased the acceptance ($p \leq 0.05$). As for color, the increasing of replacing level of wheat flour with mango kernel flour decreased the color of the cupcake samples, but it was acceptable in C0, C1, C2, and C3 samples (which formulated with replacing wheat flour with mango kernel powder with the levels; 0, 10, 20, and 30% mango kernel flour, respectively), while the color was clearly dark in the C_4 sample (40% mango kernel flour). There was a gradual decrease in the flavor values from the C_0 sample (control) up to the C_3 sample (30% mango kernel flour), but there were no significant differences between them, while there was a significant difference between the C_4 sample (40% mango kernel flour) and all other samples (C_0, C_1, C_2, and C_3) (which formulated with 0, 10, 20, and 30% mango kernel flour, respectively).

It was also noticed that there was a tiny bitterness that increased with the addition of

mango kernel flour, but there were no significant differences between samples up to the C_3 sample (30% mango kernel flour), while there was a significant difference between the C_4 sample (40% mango kernel flour) and other samples. Regarding the texture, the hardness was improved slightly as the level of replacing wheat flour with mango kernel powder increased, to the extent of 30%, with no significant differences between them. While at replacing level of 40%, the texture became more solid.

In addition, the overall acceptability scored highly acceptable for C1 (10% mango kernel flour), followed by C2 (20% level), and then C3 (30% level) compared to the control sample (C0), while the C4 sample (40% level) was unacceptable.

Rheological characteristics:

Farinograph:

Table 7 displays the farinograph measurements of wheat flour, and wheat flour/ mango kernel powder mixtures.

The water absorption (the amount of water needed or required by the mixture of flour and water (dough) to bring the curve to the U.B 500 line) is rapidly increased as the percentage of substitution wheat flour with mango kernel flour increased, it ranged from 58.00 to 59.00%. According to **Abd El-Moniem and Yaseen (1993)**, this increase in water absorption could be attributed to the higher fiber content of mango kernel powder as compared to wheat flour.

Also, the arrival time (the time needed for the curve to reach the 500 line after running the blender, and adding water) remained constant in C_0, C_1 and C_2 samples (1.5 min), but it was not known in C_3 and C_4 samples. While it could be noticed that the dough development time (It is calculated to the nearest half minute from the beginning of adding water to form the dough until the dough reaches stability (before the weakening stage) **(Dapcevic *et al.*, 2011)** followed a similar trend as water absorption, which is raised as the level of replacing wheat flour with mango kernel powder is increased.

Table (7): Farinograph parameters of dough prepared with mango kernel powder:

Parameters	Formulas					
	C_0	C_1	C_2	C_3	C_4	LSD at 5%
Water absorption (%)	58.00^{b}	58.50^{ab}	59.00^{a}	—	—	0.76
Arrival time (min)	1.50^{a}	1.50^{a}	1.50^{a}	—	—	4.08
Dough development time (min)	3.50^{b}	9.00^{a}	9.00^{a}	—	—	2.89
Stability time (min)	14.50^{a}	>12.00^{b}	>12.00^{b}	—	—	1.67
Degree of softening (B.U) time (min)	20.00	—	—	—	—	—

Note: C0: control sample; C1: cupcakes with kernel powder 10%; C2: cupcakes with kernel powder 20%; C3: cupcakes with kernel powder 30%; C4: cupcakes with kernel powder 40%.

Time required for dough stability (it is calculated per minute to the nearest half-minute between the arrival time and the departure time, that is, between the irst point on the curve that touches the 500 b.r. unit line is closest to the point on the curve when the curve begins to diverge from the 500 b.r. line.) **(Dapcevic *et al.*, 2011).** The dough stability time was decreased from 14.5 minutes for the control sample to over 12 minutes for the C_1 and C_2 samples (10 and 20% level). This decrease in time of stability showed a deficit in dough strength, which represents a decrease in wheat gluten content (dilution impact) in the blends. These findings were consistent with those obtained by **Ajila et al. (2008).** Regarding, the softening degree, (it is the difference in Brabender units between the 500 b.r. line and the center of the curve twelve minutes after reaching maximum strength) **Dapcevic *et al.*, (2011).** The samples with low dough stability showed a direct decrease in softening. As a result, as the replacement level of wheat flour with mango kernel powder increased, the softening degree decreased progressively until the degree of softening value in samples C_2, C_3, and C_4 reached less than the minimum that the farinograph could recognize, so no value appeared for the C2, C3, and C4 samples.

These findings contradict those reported by **Ashoush and Gadallah (2011).**

Extensograph parameters:

It was obvious that the replacement level of wheat flour with mango kernel powder influenced the extensograph parameters. Elasticity expresses the force that increases in a regular manner when the dough is stretched quickly until it tears and it is measured in Brabander units **(Dapcevic et al., 2011).** As shown in Table 8, the increasing of the substitution level of wheat flour with mango

kernel powder reduced the maximum resistance of extension (elasticity) from 640 B.U. for the control to 520 B.U. for the C_4 sample. Also, extensibility decreased from 140 mm in control to 50 mm in C4 sample. In addition, the proportional number is the maximum resistance (B.U) divided by the extensibility(mm) **(Dapcevic et al., 2011)** was increased by increasing the replacement level of wheat flour with mango kernel powder (6.52, 8.28, 9.17 and 10.5 for C_1, C_2, C_3 and C_4, respectively) compared to control sample (4.57). Moreover, the energy value was 136 cm2 for control sample and decreased to 78, 54, 46, and 34 cm^2 for for C_1, C_2, C_3 and C_4, respectively.

These results agree with those obtained by **Ashoush and Gadallah (2011)** who reported that all extensograpgh parameters decreased with increase the level of wheat flour replacing with mango kernel powder in producing of biscuits, while this increment led to an increase in the Proportional number.

Table (8): Extensograph parameters of dough prepared with mango kernels powder:

Parameters	Treatments					
	C_0	C_1	C_2	C_3	C_4	LSD at 5%
Resistance or Elasticity	640^a	620^b	580^c	550^d	520^e	0.25
Extensibility	140^a	95^b	70^c	60^d	50^e	0.75
Proportional number	4.57^c	6.52^{bc}	8.28^{ab}	9.17^a	10.5^b	2.58
Energy (Cm^2)	136^a	78^b	54^c	46^d	34^e	0.85

Note: C0: control sample; C1: cupcakes with kernel powder 10%; C2: cupcakes with kernel powder 20%; C3: cupcakes with kernel powder 30%; C4: cupcakes with kernel powder 40%.

CONCLUSION

Finally, it could be concluded that mango kernel powder can be used as a partial replacer of wheat flour up to 30% in producing cupcake without any detrimental effect on the sensory characteristics with improving the nutritious profile.

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

AUTHORS CONTRIBUTION

The authors confirm contribution to the paper as follows: study conception and design: Rahma M. Farhat, Ashraf M. Sharaf and Zeinab S. Farag; data collection: Rahma M. Farhat; analysis and interpretation of results: Rahma M. Farhat, Ashraf M. Sharaf and Zeinab S. Farag; draft manuscript preparation: Rahma M. Farhat and Ashraf M. Sharaf. All authors reviewed the results and approved the final version of the manuscript.

REFERENCES

AACC (2010). American Association of Cereal Chemists. Approved Methods of the A.A.C.C. Published by the American Association of Cereal Chemists, 10th Ed., St. Paul, MN. USA.

AOAC (2016). Association of Official Analysis Chemists International Official methods of analysis (20thed.), Washington, DC, USA.

Abd El-Moniem, G.M. and A.A. Yaseen (1993). High dietary fiber cookies from several sources of bran or husk. Egypt J. Food Sci., 21 (2): 157-170.

Ajila, C.M., M. Aalami, K. Leelavathi and U.J.S. Prasada Rao, 2010. Mango peel powder: A potential source of antioxidant and dietary fiber in macaroni preparations. Innovative Food Science and Emerging Technologies, 11: 219-224.

Akter, N. and Alim, M.A. (2018). Preparation of wheat-potato-peanut composite flour cakes, J. Bangladesh Agric. Univ, 16 (2): 315-321.

Ashoush, I.S. and Gadallah, M.G.E. (2011). Utilization of Mango Peels and Seed Kernels Powders as Sources of Phytochemicals in Biscuit. World Journal of Dairy and Food Sciences, 6 (1): 35-42.

Chaplin, M.F. (2003). Fiber and water binding, Proceedings of the Nutrition Society, 62: 223-227

Chen, H., Rubenthaler, G.L., Leung, H.K. and Baranowski, J.D. (1998). Chemical, Physical, and Baking Properties of Apple Fiber Compared with Wheat and Oat Bran. Cereal Chem, 65 (3):244-247.

CIE (2004). Commission Internationale de l'Eclairage, Colorimetry Vienna, Austria.

Dakare, A., Ameh, D.A., Agbaji, A.S. and Atawodi, E. (2012). Effects of Processing

Techniques on the Nutritional and Antinutritional Contents of Mango (*Mangifera indica*) Seed Kernel. World J Young Researchers, 2(3): 55-59.

Dapcevic, T., Pojic, M., Hadnaev, M., and Torbic, A. (2011). The Role of Empirical Rheology in Flour Quality Control. InTech. doi: 10.5772/24148

Das, P., Khan, M.J., Rahman, M.S., Majumder, S., and Islam, M.N. (2019). Comparison of the physico-chemical and functional properties of mango kernel flour with wheat flour and development of mango kernel flour based composite cakes, NFS Journal, 17: 1-7.

Faten, Y. Ibrahim, Aboulnaga E.A., Youssif, M.R.G. and El-Gaafary M.A. (2018). Effect of Substitution with Mango Peels and Seed Kernels as By-Products on the Quality of Pan Bread and Cake. Journal of Food and Dairy Sciences, 9: 439-445.

Fowomola, M. A. (2010). Some nutrients and antinutrients contents of mango (Magnifera indica) seed. African Journal of Food Science, 4(8): 472 – 476.

Gumte, S.V., Taur, AT., Sawate, A.R. and Kshirsagar, R.B. (2018). Effect of fortification of mango (*Mangifera indica*) kernel flour on nutritional, phytochemical and textural properties of biscuits. Journal of Pharmacognosy and Phytochemistry, 7(3): 1630 – 1637.

Isik, F., Urganci, U. and Turan, F. (2017). Some chemical, physical and sensory properties of muffin cakes with blueberries (*Vaccinium sp*.). Academic Food Journal, 15(2): 130 - 138.

Joint, F. A. O., WHO Expert Committee on Nutrition, and World Health Organization. (1971). Joint FAO/WHO Expert Committee on Nutrition: eighth report, food fortification, protein-calorie malnutrition, Geneva, Switzerland, 9-18 November 1970. World Health Organization.

Kaur, A., and Brar, J.K. (2017). Use of Mango Seed Kernels for the Development of Antioxidant Rich Biscuits, 6(8): 536.

Lauricella, M., Emanuele, S., Calvaruso, G., Giuliano, M. and D'Anneo, A. (2017). Multifaceted Health Benefits of *Mangifera indica L*. (Mango): The Inestimable Value of Orchards Recently Planted in Sicilian Rural Areas. Nutrients. 9(5):525.

Lawson, T., Lycett, G. W., Ali, A. and Chin, C. F. (2019). Characterization of Southeast Asia mangoes (*Mangifera indica L*) according to their physicochemical attributes. Scientia Horticulture, 243: 189-196.

Mahmoud, E. A., Abdelmohsen, S. A., and Elansary, H. O. (2021). Husk Cherry: Nutritional attributes, bioactive compounds, and technological applications. Arabian Journal of Chemistry, 14(11): 103-402.

Mutua, J. K., Imathiu, S. and Owino, W. (2017). Evaluation of the proximate composition, antioxidant potential and antimicrobial activity of mango seed kernel extracts. Food Science and Nutrition, 5(2): 349-357.

Reddy, L., Wee, Y.J., Ye, W. and Korivi, M. (2021). Nutritional Composition and Bioactive Compounds in Three Different Parts of Mango Fruit. International Journal of Environmental Research and Public Health, 18: 741. 10.3390/ijerph18020741.

Sudhakar, D.V. and Maini, S.B. (2000). Isolation and characterization of mango peel pectin. Journal of Food Processing and Preservation, 24: 209-227.

Thenabadu, M. and Seneviratne, H.A. (2022). Utilization of Mango (*Mangifera indica L*.) Seed Kernel Flour as a Novel Ingredient for Muffins, 6(5): 2454-6194.

Topkaya, C. and Isik, F. (2019). Effects of pomegranate peel supplementation on chemical, physical and nutritional properties of muffin cakes. Journal of Food Processing and Preservation, 43(6):13868.

Torres-León, C., Rojas, R., Contreras-Esquivel, J. C., Serna-Cock, L., Belmares-Cerda, R. E. and Aguilar, C. N. (2016). Mango seed: Functional and nutritional properties. Trends in Food Science and Technology, 55: 109-117.

استخدام مسحوق نواة المانجو (*Mangifera indica L.*) كبديل جزئي لدقيق القمح في إنتاج الكب كيك

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كان الهدف الأساسي من هذا البحث هو استخدام مسحوق نواة المانجو كبديل جزئي لدقيق القمح في صنع الكب كيك بمستويات الاستبدال التالية: 0، 10، 20، 30، 40% ودراسة تأثير هذا الاستبدال على الخصائص الفيزيائية والكيميائية والريولوجية والحسية لدقيق القمح ومخاليط دقيق القمح / نواة المانجو والكب كيك المنتج. أظهرت النتائج أن مسحوق نواة المانجو (صنف: الجهراوي) يحتوي على التركيب الكيميائي التالي: و 6و36، 12و 2.09و 4.38و65.75% للرطوبة، البروتين و الدهون و الرماد و والكربوهيدرات على التوالي. وقد أشارت الخصائص الحسية لعينات الكب كيك إلى أن استبدال دقيق القمح بمسحوق نواة المانجو كان له تأثير كبير على قبول المنتج. وأظهرت التقييمات النهائية أن عينة الكب كيك المنتجة باستبدال دقيق القمحج بمسحوق نواة المانجو بنسبة 10 ٪ (C_1) كانت مقبولاة للغاية وكان على قدم المساواة مع عينة المقارنة (C_0) واستناداً إلى خصائص اللون، يمكن ملاحظة أن الخفة ((L*) لعينات الكب كيك تقل مع زيادة مستوى الاستبدال. كما أظهرت النتائج أن استبدال دقيق القمح بمسحوق نواة المانجو نتج عنه زيادة في الرطوبة والدهون والألياف والرماد في عينات الكب كيك. وأخيرًا أدي استبدال دقيق القمح بمسحوق نواة المانجو حتي نسب استبال تصل إلى 30% إلى تحسين المظهر الغذائي والصفات الحسية للكب كيك المنتج.

الكلمات المفتاحية: دقيق نواة بذور المانجو، كب كيك، المعادن، خصائص اللون، التقييم الحسي.