Food Technology Research Journal, Vol. 4, issue 1, 64-72, 2024

FTRJ

Chemical, Sensory and Quality Evaluation of Cupcakes with Wheat Flour, Oat Flour and Strawberry Powder

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Original Article

Article information
Received 01/05/2024
Revised 15/05/2024
Accepted 30/05/2024
Published 05/06/2024
Available online 10/06/2024

Keywords:
Cake, Oat, Strawberry powder.

ABSTRACT

Cupcakes are a popular treat enjoyed by people of all ages. This study aimed to develop cupcakes with improved nutritional value by incorporating whole-wheat oat flour and strawberry powder. Whole oat flour is a good source of protein, fat, and fiber compared to wheat flour. It also boasts the highest β-glucan content (1.69%), followed by wheat flour (0.13%). Additionally, oat flour is relatively high in magnesium, iron, and zinc. Strawberry powder, on the other hand, is a good source of calcium, iron, sodium, and potassium. Cakes made by substituting wheat flour with different levels of oat flour and 15% strawberry powder showed significantly higher levels of moisture, protein, ash, dietary fiber, beta-glucan, and carotene compared to the control group. Mineral content also increased significantly with the addition of 15% strawberry powder and different oat flour levels. However, incorporating both strawberry powder and whole oat flour into the cupcakes negatively impacted their volume and specific volume, while weight and density increased. Hardness and gumminess also increased with higher oat flour substitution. On a positive note, the addition of 15% strawberry powder led to an improvement in all sensory parameters measured. Up to 35% oat flour inclusion resulted in cupcakes with favorable odor, taste, and texture.

1. Introduction

Bakery products are a staple in many diets, and cakes are particularly popular due to their deliciousness and variety. From a scientific standpoint, cakes can be a good platform for experimenting with alternative flours like oat flour instead of traditional wheat flour. This is because cakes can be formulated to be gluten-free while still achieving high quality. De La Hera et al. (2013) demonstrated this potential by successfully creating cakes using oat flour. This opens up exciting possibilities for developing cakes with enhanced nutritional value, particularly those high in fiber. Oats, belonging to the Poaceae family and Avena Sativa species, are among the most nutritious grain cereals. Rich source of protein and fiber, along with essential vitamins and minerals (Ahmad and Zaffar, 2014). Zhu et al. (2020) shows that whole oat flour is particularly beneficial, containing significant amounts of protein (14.88 g/100g), fat (8.16g/100g), dietary fiber (13.53 g/100g), and beta-glucan. Additionally, oats also provide valuable source of essential and nonessential amino acids. According to Ibrahim et al. (2020), consuming just 100 to 120 grams of oats can provide an individual weighing 70 kg with the recommended daily intake of 5.8 grams of essential amino acids. Several recent studies highlight the potential health benefits of oat beta-glucan. Yu et al. (2022) demonstrated that consuming oat beta-glucan in the diet can significantly reduce total cholesterol (TC) and LDL cholesterol levels, particularly in individuals with high cholesterol (hypercholesterolemia). Similarly, García-Cordero et al. (2023) reported that regularly taking food supplements containing oat beta-glucan may improve diastolic blood pressure (DBP) and VLDL cholesterol levels, both of which are important for cardiovascular health.

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Strawberry plant, classified under the Rosaceae family and Fragaria genus, Present a unique opportunity to reduce food waste and create valuable products. These products hold both commercial and health significance. Strawberries are a rich source of vitamin C and provide a significant amount of folate (20-25mg/100g fresh weight). Strawberries contain other vitamins, albeit in smaller quantities, including thiamin, riboflavin, niacin, vitamin B6, vitamin K, vitamin A, and vitamin E (Giampieri et al., 2012). The objective of this study is to develop cupcakes incorporating whole meal oat flour and strawberry powder to enhance the nutritional value of cupcakes.

2. Materials and Methods

Materials

Wheat flour (72% extract) was obtained from South Giza Flour Mills Company, Egypt, whole oat flour and fresh strawberry were obtained from carrefour market.

Preparation of strawberry powder

Fresh strawberries are washed thoroughly to remove dirt and debris. They are then cut into thin slices. The sliced strawberries were directly immersed in Solution containing 1% NaCl, They are then immersed, immersed in a solution containing sodium meta-bisulphite (1%) and citric acid (0.5%) for 3 min (Shih et al., 2009). Strawberry slices were dried for 24h at 55°C. Once completely dry, the strawberry slices are milled into a fine powder. The final strawberry powder was then packed into polyethylene bags and stored at -20ºC.

Cupcakes preparation

The developed cupcake formulation showed in based on the procedure outlined by Bennion and Bamford (1997). The baked cupcakes were individually packaged in metalized polyethylene plastic bags. A sample of the cupcakes was then reserved for further testing and evaluation.

Table 1. The recipe formulation of cupcake for 100g flour.

Ingredients (gm)	Control	F1	F2	F3	F4
Wheat flour (72%)	100.0	85	70	50	35
Whole Meal Oat flour	-	-	15	35	50
Strawberry powder	-	15	15	15	15
Whole fresh eggs	25.0	25.0	25.0	25.0	25.0
Dry skimmed milk	10.0	10.0	10.0	10.0	10.0
Butter	21.5	21.5	21.5	21.5	21.5
Sugar	60.0	60.0	60.0	60.0	60.0
Baking powder	4.50	4.50	4.50	4.50	4.50
Vanilla	1.50	1.50	1.50	1.50	1.50
Table Salt	1.00	1.00	1.00	1.00	1.00
Water	As needed				

Chemical analysis

The moisture content, crude protein, total fat, and ash content of both the raw materials and the baked cupcakes were determined using standard methods outlined by the AOAC (Association of Official Analytical Chemists) in 2010.Total carbohydrates was not directly measured but rather calculated by difference., microwave digestor (Multiwave GO Plus 50 HZ) was used to prepare the samples for mineral analysis. Microwave Plasma-Atomic Emission Spectroscopy (MPAES) was used to identify and quantify the minerals present in the samples. (Agilent, Mulgrave, Victoria, Australia) as described by Helal and Nassef (2021)

Physical properties for cupcakes

The weight of each cupcake (g) was recorded after cooling for 1hr. Cupcake height was measured to the nearest millimeter using micrometer. Weight (g) was measured according to the method described in AACC (2010). Volume (cm^3) was measured by seed displacement was determined according to AACC (2010). Specific volume (cm3/g) of cupcake was then calculated by dividing volume by weight of cupcake according to the

method described in (AACC, 2010).

Texture profile analysis (TPA) of cupcakes

To assess the textural properties of the cupcakes, a Texture Profile Analysis (TPA) was conducted following the criteria outlined by Baixauli et al. (2008). A universal testing Brook field Engineering Lab. Inc., Middleboro, MA 02346- 1031, USA) device was used to identify. the specifications for cupcake texture During the TPA, a cylindrical probe with a diameter of 25 mm was used to compress the cupcake sample at a speed of 2 mm/s.

Sensory evaluation of cupcakes

Following baking, the cupcake samples were cooled for 4 hours at 25°C. To allow for organoleptic qualities. Ten trained panelists (five men and five women) from the Food Technology Research Institute staff participated in the sensory evaluation. Each panelist received a single slice of each cupcake sample presented on a white, odorless, and disposable plate. The panelists evaluated the cupcakes based on the following attributes using a scale of 10 (lowest) to 20 (highest) points, following the method outlined by Bennion and Bamford (1997).

Statistical Analysis

The data collected from the various analyses (chemical composition, physical properties, sensory evaluation, etc.) were analyzed using the SPSS 20.0 software program.. Means and standard deviations were determined using descriptive statistics. Comparisons between samples were determined using analysis of one-way variance (ANOVA) and multiple range tests. Statistical significance was defined at $P \leq 0.05$ (Steel and Torrie 1986).

3. Results and Discussion

Chemical Composition of Raw Materials

Table 2 presents the chemical composition of wheat flour, oat flour, and strawberry powder Used in this study. As expected, the analysis reveals that oat flour is a richer source of protein, fat, and fiber compared to wheat flour and strawberry powder. This aligns with previous research by Youssef et al. (2016) who reported that oat flour contains moisture levels from 9.96% to 10.47%, crude protein levels from 11.61% to 13.62%, crude fat levels from 7.23% to 8.92%, crude fiber levels from 3.53% to 5.87%, ash levels from 2% to 2.15%, and carbohydrate levels from 69.43% to 75.62% for red and common oat flours. The analysis of fat content, whole meal oat flour exhibited a higher fat content at 6.85%, compared to just 2.88% in whole wheat flour. Both wheat flour and whole meal oat flour displayed notable ash content, with the highest percentage found in strawberry powder at 3.70%, followed by oat flour at 3.01%. Oat flour exhibited the highest crude fiber content at 7.69%, conversely whole wheat flour displayed the lowest content at 3.59%. Whole wheat flour boasted the highest content at 77.29%, while oat flour had the lowest at 66.46%. Table 2 also presents the β-glucan and dietary fiber content of wheat flour, oat flour, and strawberry powder. Oat flour exhibited the highest β-glucan content at 1.69%, followed by wheat flour at 0.13%. These results align with a study by Berski et al. (2014). In terms of dietary fiber, oat flour had the highest content at 13.69%, followed by strawberry powder at 9.25%, while wheat flour had the lowest content at 5.11%. These findings are consistent with a study by Majzoob et al. (2014), which reported that oat flour contained 14.3% dietary fiber compared to only 5.4% in wheat flour.

Minerals Content of Raw Materials

Table 3 presents the mineral composition of wheat flour, oat flour, and strawberry powder. The data revealed that oat flour was relatively higher in magnesium (115mg/100g), iron (4.94mg/100g) and zinc (3.85mg/100g). These findings are consistent with research by (Levent and Bilgiçli, 2012). These findings are consistent with research by, strawberry powder. Calcium content (177.12 mg/100g). It also contained appreciable amounts of iron (4.90 mg/100g), sodium (10.11mg/100g), and potassium (1510.25mg/100g). These results align with the observations reported by Afify et al. (2022).

Table 2. Chemical Composition of Raw Materials (g/100 g, on dry weight basis)

Composition (%)	Wheat Flour (72%)	Whole Meal Oat flour	Strawberry Powder
Moisture	10.11^{b} ±0.02	9.90^{c}±0.07	11.20^{a}±0.09
Protein	11.21^{b} ±0.05	13.55^{a} ±0.04	2.33^{c}±0.02
Ash	0.50^{b} ±0.07	3.01^{a} ±0.01	3.70^{a}±0.05
Fat	1.15^{b} ±0.02	8.91^{a} ±0.09	1.40^{b}±0.07
Fibers	0.95^{c} ±0.08	7.69^{a} ±0.11	6.89^{b}±0.12
Carbohydrates*	86.19^{a} ±0.12	66.94^{b} ±0.15	85.68^{a}±0.19
Beta-glucan %	0.13^{b} ±0.04	1.69^{a} ±0.02	0.00
Dietary fiber %	5.11±0.09	13.69^{a} ±0.12	9.25^{b}±0.05
Carotene	0.00	0.00	38.60^{a}±0.22

Mean of triplicate determination ± standard deviation. Means with the same letter in the same row are not significantly different ($p<0.05$). *Carbohydrates Calculated by difference.

Table 3. Minerals Content of Raw Materials (mg/100g on dry weight basis)

Minerals	Wheat flour	Oat flour	Strawberry Powder
Ca	19.17^{c}±0.08	75.50^{b}±0.06	177.12^{a}±0.02
Mg	110.25^{a}±0.15	115.00^{a}±0.12	91.88^{b}±0.17
Fe	1.00^{c}±0.05	4.94^{b}±0.09	4.90^{b}±0.06
Zn	0.98^{c}±0.07	3.65^{a}±0.06	1.69^{b}±0.03
Na	4.10^{a}±0.09	4.74^{a}±0.02	10.11^{b}±0.08
K	117.56^{c}±0.25	363.00^{b}±0.18	1510.25^{a}±0.12

Mean of triplicate determination ± standard deviation.
Means with the same letter in the same row are not significant different ($P<0.05$).

Chemical Composition of Cupcake

Table 4 presents the chemical composition of cupcakes formulated with oat flour. It was found that proximate composition of cupcake samples with varying levels of oat flour, wheat flour, and strawberry powder (15%) compared to a control group. The addition of 15% of strawberry powder to the cupcakes resulted in an increase in moisture, ash and crude fiber. Moisture content increased, while ash content rose due to the naturally high ash level in strawberry powder (as shown in Table 2). Ash content ranged from 0.81% to 1.79% across the cupcake formulations. The increase in fiber content can also be attributed to the fiber present in strawberries. Conversely, protein, fat, and carbohydrate content decreased in the cupcakes with added strawberry powder. This might be due to the dilution effect caused by the strawberry powder, which has lower levels of these components compared to wheat flour. These findings align with previous research. Afify et al. (2022) observed a similar increase in ash content when adding strawberry powder to rice biscuits. Similarly, Damirchi and Salehifar (2021) reported that incorporating acorn flour and pumpkin powder into flour increased fiber content and water absorption capacity. Cakes made with oat flour (oat flour-produced cakes) have a higher moisture content, protein, ash, fiber, and total carbohydrate content compared to control cakes. Generally, from the data presented in Table 4., the contents of protein, ash, fat, crude fiber, dietary fiber and B-glucan in cupcakes showed a significant and gradual increase by increasing the substitution level of wheat flour (72% ext.) with whole meal oat flour. The results agree with work by Mousa (2022) who reported that the proximate composition of cake of different mixing levels with oat flour showed an increase in moisture, ash, fat and fiber compared to control. The highest moisture content was found in cupcakes prepared with 50% oat flour, compared to the control. Rossel et al. (2001) attributed the increased moisture content to the presence of hydroxyl groups in the oat fiber structure. These hydroxyl groups can form bonds with

water molecules, leading to higher moisture retention. The study also evaluated the beta-glucan content of the oat flour cakes. Beta-glucan content increased significantly with increasing oat flour levels compared to the control. The beta-glucan content rose from 0.11% to 0.21%. These results align with the findings of Mousa (2022).

Table 4. Chemical composition of cupcake containing whole meal oat flour (% on dry weight basis)

Samples	C	F1	F2	F3	F4
Moisture (%)	22.69±0.14^{e}	22.94±0.15^{d}	23.10±0.12^{c}	23.26±0.13^{b}	23.39±0.17^{a}
Protein (%)	6.50±0.09^{c}	6.14±0.02^{d}	6.57±0.06^{c}	6.73±0.08^{b}	6.95±0.05^{a}
Ash (%)	0.81±0.03^{d}	1.25±0.08^{c}	1.30±0.05^{c}	1.55±0.06^{b}	1.79±0.01^{a}
Fat (%)	10.15±0.07^{d}	10.13±0.06^{d}	10.37±0.09^{c}	10.60±0.02^{b}	10.90±0.03^{a}
Crude Fiber (%)	1.09 ±0.08^{e}	1.85±0.03^{d}	2.01±0.02^{c}	2.65±0.05^{b}	3.53±0.09^{a}
Carbohydrates (%)	81.45±0.09^{a}	80.63±0.11^{b}	79.75±0.13^{c}	78.47±0.15^{d}	76.83±0.14^{e}
Dietary Fiber (%)	5.15±0.03^{d}	5.53±0.08^{c}	5.64±0.05^{c}	6.36±0.04^{b}	6.88±0.08^{a}
B-glucan (%)	0.10±0.05^{d}	0.09±0.06^{d}	0.13±0.03^{c}	0.17±0.07^{b}	0.21±0.02^{a}
Carotene	0.06±0.02^{c}	2.42±0.04^{a}	2.41±0.07^{a}	2.40±0.03^{b}	2.39±0.09^{b}

Mean of triplicate determination ± standard deviation.
Means with the same letter in the same row are not significant different (P<0.05). Available carbohydrates calculated by difference

Minerals composition of cupcake

Table 5. presents the analysis of mineral content in wheat-oat and strawberry cakes. .The mineral content of calcium, magnesium, iron and zinc in cupcakes showed a gradual and significant increase by increasing whole meal oat flour in cupcakes compared to control sample. These findings align with the research by (Morsy 2022). The growing interest in incorporating oat flour into bakery products stems from its superior nutritional value. Oat flour boasts a higher content of essential minerals like potassium, calcium, manganese, and iron compared to wheat flour.

Table 5. Minerals composition of cupcake (mg/100gm, on dry weight basis)

Elements (mg/100gm)	C	F1	F2	F3	F4
Ca	169.68^{d}±0.12	178.28 ^{c} ±0.10	182.04^{b}±0.09	185.20^{a} ±0.14	189.59^{a}±0.1
Mg	15.06 ^{e}±0.04	19.23^{d} ±0.03	24.95^{c}±0.05	30.63^{b}±0.07	38.18^{a}±0.03
Fe	0.75^{b}±0.03	1.07 ^{a} ±0.04	1.08^{a} ±0.02	1.09^{a}±0.03	1.10^{a}±0.05
Zn	0.57 ^{d}±0.04	0.63 ^{d} ±0.02	1.69^{c} ±0.03	2.74 ^{b}±0.05	4.14^{a}±0.07
Na	381.51^{b}±0.15	385.12^{a} ±0.11	383.99^{ab} 0.13	382.87^{b}±0.17	381.86^{b}±0.12
K	129.08^{e}±0.18	262.99±0.09^{a}	228.37^{c}±0.04	243.15^{b}±0.15	213.46^{d}±0.17

Mean of triplicate determination ± standard deviation.
Means with the same letters in the same row are not significant difference (p<0.05).

Physical properties of cupcake

The effects of incorporating whole oat flour at varying levels (15%, 30%, and 50%) on the physical properties of cupcakes made with wheat flour and 15% strawberry powder are presented in Table 6. The analysis revealed a positive correlation between the level of oat flour incorporated and the weight of the cupcakes. The sample containing 50% whole oat flour exhibited the highest weight (34.35 grams), while the control sample with no oat flour had the lowest weight (25.50 grams). This observed weight increase can likely be attributed to the high fiber content of both whole wheat flour and oat flour. Fiber is known for its water holding capacity, which can contribute to a greater overall weight in the final baked good. In contrast, the cake volume exhibited an opposite trend. The volume of the cakes decreased gradually from 53.90cm³ to 47.95

cm^3 as the oat flour proportion increased from 0% to 50%. These finding aligns with research and is likely due to the dilution of gluten caused by the added oat flour, as explained by Akubor and Ishiwu (2013). Gluten plays a Critical role in trapping carbon dioxide Produced during baking, which leads to volume expansion and a characteristic spongy texture. Consequently, a reduction in gluten levels due to oat flour substitution can result in decreased cake volume and a denser texture. The incorporation of both whole oat flour and strawberry powder into the cupcakes had opposing effects on weight/density and volume/specific volume. While weight and density increased with increasing levels of oat flour, volume and specific volume exhibited a negative trend. This suggests that the combination of these ingredients, particularly at higher inclusion rates, may lead to denser cakes with lower overall volume.

Table 6. Physical properties of cupcake samples containing different ratios of whole meal oat flour

Samples	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)	Density (gm/ cm3)
C	$25.50^{e}\pm0.12$	$53.90^{a}\pm0.04$	$2.11^{a}\pm0.09$	$0.47^{e}\pm0.06$
F1	$26.98^{d}\pm0.03$	$51.50^{b}\pm0.06$	$1.91^{b}\pm0.11$	$0.52^{d}\pm0.12$
F2	$28.17^{c}\pm0.09$	$50.69^{c}\pm0.14$	$1.80^{c}\pm0.03$	$0.56^{c}\pm0.07$
F3	$31.25^{b}\pm0.06$	$49.25^{d}\pm0.12$	$1.58^{d}\pm0.14$	$0.63^{b}\pm0.09$
F4	$34.35^{a}\pm0.14$	$47.95^{e}\pm0.09$	$1.39^{e}\pm0.07$	$0.72^{a}\pm0.03$

Mean of triplicate determination ± standard deviation.
Means with the same letters in the same column are not significant different ($p<0.05$).

Texture profile analysis of cupcakes

The textural properties of cupcakes as influenced by strawberry powder and oat flour (Table 7). Hardness, a key factor in consumer preference, was measured as the maximum force required to break the cupcake structure. The control cupcakes exhibited the lowest hardness (3.34N), while cupcakes formulated with 50% oat flour displayed the highest hardness (7.50N). This trend indicates a significant increase in hardness with increasing oat flour levels. Similarly, gumminess, which reflects the energy needed to chew and swallow the cupcake, increased along with hardness. Higher oat flour substitution resulted in both harder and gummier cupcakes.

Table 7. Texture profile analysis of produced cupcake

Sample	Hardness (n)	Gumminess (n)	Springiness (mm)	Chewiness (mj)
C	$3.34^{e}\pm0.07$	$8.40^{e}\pm0.09$	$7.00^{a}\pm0.04$	$19.80^{e}\pm0.09$
F1	$3.96^{d}\pm0.12$	$10.00^{d}\pm0.10$	$6.15^{b}\pm0.09$	$23.12^{d}\pm0.11$
F2	$4.20^{c}\pm0.09$	$13.10^{c}\pm0.05$	$5.29^{c}\pm0.11$	$25.90^{c}\pm0.09$
F3	$5.00^{b}\pm0.06$	$14.25^{b}\pm0.11$	$4.11^{d}\pm0.07$	$30.32^{b}\pm0.06$
F4	$7.50^{a}\pm0.04$	$15.42^{a}\pm0.04$	$3.06^{e}\pm0.13$	$41.24^{a}\pm0.04$

Mean of triplicate determination ± standard deviation.
Means with the same letters in the same column are not significant different ($p<0.05$).

Springiness, an indicator of how well a cake bounces back after being pressed, was highest in the control cupcakes (7.00) and decreased significantly with increasing oat flour content, reaching a low of 3.06 in the 50% oat flour sample. This suggests that oat flour makes the cupcakes less elastic.

Chewiness, which reflects the effort required to chew the cake before swallowing, followed the opposite trend. The control cupcakes had the lowest chewiness (19.80), while samples with higher oat flour levels (50%) exhibited the highest chewiness (41.24). This indicates that oat flour contributes to a chewier texture.

Table 8. Sensory properties of cupcake produced from wheat flour substituted with whole meal oat flour and strawberry powder.

Sample	Color (9)	Taste (9)	Odor (9)	Texture (9)	Overall acceptability (9)
C	8.40^{a}±0.13	8.17^{a}±0.17	8.33^{a}±0.15	8.67^{a}±0.18	7.67^{a}±0.16
F1	8.50 ^{a}±0.19	8.30 ^{a}±0.14	8.45 ^{a}±0.19	8.50 ^{a}±0.11	7.75 ^{a} ±0.13
F2	8.40 ^{a}±0.15	8.10^{ab}±0.10	8.23^{ab}±0.14	8.20^{ab}±0.13	7.63^{ab}±0.18
F3	8.30^{b}±0.18	8.00^{b}±0.15	8.00^{b}±0.10	8.00^{b}±0.15	7.57^{b}±0.12
F4	7.20^{c}±0.11	6.33^{c}±0.16	6.67^{c}±0.18	6.33^{c}±0.17	6.00^{c}±0.15

Mean of ten determinations ± standard deviation.
Means with the same letters in the same column are not significant different ($p<0.05$).

Sensory properties of cupcakes

Table 8. explores how different oat flour and strawberry contents affect the sensory properties of cupcakes. The addition of 15% strawberry powder led to an improvement in all measured parameters. However, when oat flour was added, the sensory attributes were influenced differently. Up to 35% oat flour substitution yielded cupcakes with favorable odor, taste, and texture. However, panelists rated the flavor, taste, and overall acceptability significantly lower for cupcakes containing 50% oat flour. Notably, taste received the lowest scores at this level. Notably, taste received the lowest scores at this level. While color scores decreased slightly with increasing oat flour levels (0% to 35%), they remained within the "good to excellent" range. However, a substantial decrease in color was observed at the 50% oat flour level. Overall acceptability, cupcakes containing oat flour up to 35% received higher approval from the panelists. Conversely, cakes with 50% oat flour received the lowest overall acceptability scores compared to other samples. Additionally, a progressive decrease in cake color with increasing oat flour content. This decrement in acceptability may be attributed to the increased hardness of the texture and the darker color. Generally, from the data presented in table 8, the sensory properties of cupcakes showed a slight gradual significant decrease by increasing the substitution level of wheat flour by whole meal oat flour. These findings align with a study conducted by Majzoobi et al. (2015), which reported that the taste and texture of cakes improved when oat flour was added up to 20%. However, substitution with 30% oat flour resulted in an inferior taste and texture of the cake.

4. Conclusion

The results show that replacing wheat flour (72%) with 15% strawberry powder and different levels of whole meal oat flour led to improvements in nutritional value (protein, dietary fiber, and minerals) and carotene. The addition of 15% strawberry powder led to an improvement in all sensory measured parameters, and up to 35% oat flour inclusion resulted in cupcakes with favorable odor, taste, and texture. The most preferred product was that with 15% strawberry powder and 35% whole-meal oat flour. This will help in the utilization of strawberry fruit and whole-meal oat flour. The micronutrients and fiber present in both strawberry fruit and whole-meal oat flour will provide some nutritional and health benefits for consumers.

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