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Preparation Untraditional Low Calorie Cake Formula by Taro *(Colocasia esculenta)* Mucilage

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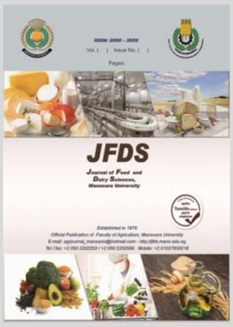

ABSTRACT

The purpose of the current study is to assess the potential of taro mucilage (TM) powder as a fat replacer in baked products. In this study the impact of replacing 25, 50, 75, and 100% of fat with TM on the chemical, physical, and sensory characteristics of cakes was evaluated. Results exhibited that the approximate chemical composition of cakes including TM exhibited a substantial rise (P≤0.05) in moisture content as the TM percentage increased in relation to a considerable decrease in fat content. When replacing cakes with TM, the caloric value decreased significantly, falling to 32.73% at the substitution of 100%. Physical properties namely height and specific volume of the cake were significantly reduced when TM was substituted at 25% of fat. While, L* values rose, but a* and b* values fell as the fat replacement percentage increased. Higher percentages of fat substitution with TM had an impact on the cake crumb stiffness. According to the sensory analysis of the cakes, every prepared cake sample was deemed acceptable. So, we conclusion that there wouldn't be any appreciable changes to the qualitative features of cakes prepared up to 25% of fat were replaced with TM.

Keywords: Cake, mucilage, taro and low fat.

INTRODUCTION

The market's increasing desire for lower-fat products has made the reduction of fat in food a serious problem today. This is connected to statistics showing a growth in the number of people who are overweight or obese over the past 30 years, which totaled more than 1400 million adults in 2008 (WHO, 2017). Obesity has been linked to a number of noncommunicable illnesses (Grundy, 2004). However, preserving the quality and traits of high-fat items is a significant issue (Dadalı and Elmacı, 2020). As a result, in order to create a reduced-fat formulation, components with diverse functions must be included to replace the quality lost when the fat is eliminated. The ingredients used as fat substitutes in the preparation of bakery products, such as breads and cakes, must serve a similar function as the original lipids, i.e., endorse aeration in the dough, provide lubrication during the mixing phase, enhance the finished texture of the products, and improve the final volume (Yazar and Rosell, 2022).

Fat imparts a pleasant flavour and a lighter consistency to the cake (Guiotto *et al.*, 2020). Furthermore, fat may postpone gelatinization of starch via slowing the transfer of water to starch granules, enhancing softness, moisture content, and flavour while also prolonging product shelf life (Pizarro *et al.*, 2013). Due to public demand, the pastry sector is presently focusing on generating low-calorie or reduced-fat products that contain a minimum of one-third fewer calories than conventional products; yet, the reduced-fat item can also be deemed healthy food (Sanchez *et al.*, 1995).

Cake fat content ranges from 15% to 27% of batter bulk (Bravo-Núñez and Gómez, 2021). Fat is a crucial element in cakes because it helps trap air throughout the whipping process, which leads to an extra-soft product. During mixing, fat is spread in the batter or dough, softening its structure and preventing protein and starch from creating an ongoing network (Therdthai, 2022).

The *Araceae* plant species taro *(Colocasia esculenta)*, which is mostly farmed in the humid tropical parts of the world, is a highly significant staple food in the human diet (Zhang and Huang, 2022). Taro production worldwide is projected at 11.8 million tonnes (Oladimeji *et al.*, 2022). The majority of worldwide output is coming from developing nations, particularly those in West Africa such as Nigeria, Cameroon, Ghana, and Ivory Coast. Egypt is ranked eighth (FAO, 2008) with 151.97 tonnes produced per year (CAPMS, 2019). The taros corm contains a large quantity of mucilage, ranging from 3 to 17% depending upon the extraction technique (Tosif *et al.*, 2022).

TM also contains carbohydrates (galactose, glucose, xylose, mannose and arabinose) and proteins (such as cysteine, leucine, tryptophan, isoleucine, and lysine) (Shanta *et al.*, 2023). It appears to be sticky and pale in colour, with carbs accounting for 46 to 69 gm/100 gm of its bulk, followed by protein accounting for 30 to 50 gm/100 gm (Tosif *et al.*, 2022). The TM created has properties that enable it to be used in a variety of processed food items, including as a thickener, gel-forming, and chelator (Zhang and Huang, 2022). Furthermore, because of its ability to hydrate, produce viscosity, and keep freshness, TM may be used as a fat substitute, notably in bread items (Syan *et al.*, 2022). There isn't enough information available on utilising

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TM to make low-fat pastry items. Thus, the goal of this study was to prepare a low-fat cake by partially or completely replacing fat with TM and to investigate its influence on the physicochemical attributes, nutritional value, and sensory quality of the cake.

MATERIALS AND METHODS

Materials:

Taro *(Colocasia esculenta)* was bought in February 2023 at a regional market situated in Kafr El-Sheikh City, Kafr El-Sheikh Government, Egypt. Following procurement, the taro rhizomes had been rinsed with tap water, peeled, and cleaned again. They were later utilised for mucilage extraction.

The cake's materials (sugar, commercial wheat flour, whole eggs, butter, baking powder, and vanilla) were acquired from a regional marketplace in Kafr El-Sheikh governorate, Egypt.

All chemicals and solvents (HPLC grade) used in this investigation were procured from Sigma Company of Chemicals and Medicines in St. Louis, MO, USA.

Taro mucilage (TM) extraction:

Taro rhizomes were divided into 300 g chunks and grinded at high speed in a commercial blender (Toouch, Type 1264, Egypt) for approximately five minutes before being homogenised. According to Basiony *et al.*(2022), the resulting mash was refrigerated at 4±1°C for six hours before being filtered through polyester cloth (30×30 Cm) with porous Forty mesh. After being lyophilized for around three days in a Liobras (L103) apparatus, it was macerated, homogenised, and kept in a desiccator until additional analyses were carried out.

Chemical characteristics of taro mucilage:

AOAC techniques were used to measure moisture, ash, protein, lipid, and crude fibre contents of taro mucilage were 935.29, 923.03, 920.87, 920.85, and 985.29 (AOAC, 2010). While the total carbohydrates content was calculated by subtracting 100 from all other components.

Functional properties of taro mucilage:

According to Basiony *et al.* (2022), the taro mucilage was distinguished by its water absorption, swelling power, oil absorption, and emulsion capacity.

Cake preparation:

The formula for the cakes mentioned in Table 1 using the modified method number 10-90 from AACC (2010). At different percentages (25, 50, 75, and 100%) TM was used instead of butter (which is, in the control formula). A Philipse RI 1341 mixer (Hamburg, Germany) was used to combine the lyophilized TM with water from the tap (3 g/100 g aqueous solution), and the mixture was then let sit at room temperature for 30 minutes.

According to AACC (2010), the standard cake preparation procedure involved the following phases in order: Flour, baking powder, and vanilla were weighed and combined. Mineta hand blender (model MT301) was used to cream both of sugar and butter for 1 minute at low speed and an extra 1 minute at high speed. Whole eggs were progressively added whilst the mixture was being creamed, and it was then continued to be creamed for a further 2 minutes using a high speed. The batter was then combined for a second time for one minute at high speed after cleaning the mixing bowl. The cake dough was quickly placed into rectangle pans (size 24X9cm, bottom diameter 5cm), and cooked at 180±5C for 20 minutes in an already-heated oven. The cakes were taken out of the pan after cooling for an hour. Before conducting physical, chemical, and sensory characterizations, the cooled cakes were placed in polypropylene bags and stored at room temperature overnight. As indicated in Table (1), the fat replacers (taro mucilage) were used during the creaming step of low-fat applications to replace 25, 50, 75, and 100% of the butter used in the cake formula.

Table 1. formula (gm) for low fat cake

Ingredients	Control	TM replacement level			
		TM-25%	TM-50%	TM-75%	TM-100%
Flour	100	100	100	100	100
Sugar	100	100	100	100	100
Butter	100	75	50	25	-
Taro mucilage	-	25	50	75	100
Eggs	100	100	100	100	100
Baking powder	2.5	2.5	2.5	2.5	2.5
Vanilla	3	3	3	3	3

Cake characterization:

Proximate composition and caloric value:

As described in 2.3, an estimate of the cake's approximate composition was made. According to Essa and Elsebaie (2022), the caloric content according to these constants 3.87 kcal/g carbohydrates, 9 kcal/g fat, and 4.02 kcal/g protein.

Physical and technological properties:

Cake's pH was tested using a Microprocessor pH Metre (HANNA Instruments pH 2011) in accordance with the AOAC (2010) procedure.

One hour after baking, the specific volume of the cakes was calculated. Rapeseed displacement AACC method 10.05 (AACC. 2010) was used to measure cake volume, and specific volume—the difference between the volume of the cake and its weight was computed. The cake's centre was used for estimating its height (in cm).

With the use of a Konica Minolta CR-410 spectrophotometer (Tokyo, Japan), the colour of the cake crumb was assessed. Measurements were made of the L* (lightness), a* (redness), and b* (yellowness) values. Two cake slices chosen from the centre of the cake were measured at five different points.

A Cometech B-type texture analyzer (Cometech, Taiwan) was equipped to test the cake samples crumb hardness at 0, 4, and 8 days after baking. Cakes were cut into slices for this examination with an electric blade (Moulinex, turkey), and the outer layer (crust) was taken off. The AACC approach (74-09.01) was used to conduct the testing (AACC, 2010).

Sensory evaluation:

Twenty qualified panellists with knowledge of evaluating cake conducted the sensory evaluation. According to Elsebaie and Essa (2018), the panellists were asked to evaluate appearance, taste, crumb colour, aroma, texture, and overall acceptability on a scale of 1 to 10. Scores range from 1 ("dislike extremely") to 10 ("like extremely").

Statistical analysis

In SPSS (Version 16.0, 2007), the general linear model was used to compare means using an ANOVA. The probability values $P<0.05$ were regarded as significant for statistical procedures. Triplicates of each measurement and test were carried out.

RESULTS AND DISCUSSION

Taro mucilage (TM) chemical composition:

For moisture, ash, crude protein, crude fat, crude fibre, and total carbohydrates, Table (2) revealed that the approximate composition of prepared TM is 6.45, 5.94, 6.70, 0.52, 2.37, and 84.47%, respectively. The moisture (6.45%), ash (5.94%), crude protein (6.70%), crude fat (0.52%), and total carbohydrates (84.47%) of the Egyptian TM were greater than those discovered by Manhivi *et al.* (2018). In comparison, the protein level of Egyptian TM is 6.70%, which is equivalent to the 6.96% found by Miamoto *et al.* (2018). The plant's state of maturity may be responsible for these variances (Tosif *et al.*, 2022).

The same table also includes data on the functional characteristics of TM. TM has a swelling power of 11.32%, which is equivalent to the 10.94% reported by Basiony *et al.* (2022). Additionally, the water absorption capacity, emulsion capacity, and oil absorption capacity are 4.61 ml/ gm, 76.14%, and 1.59 ml/ gm, respectively. These results were completely in line with those of Basiony *et al.* (2022), who reported that the TM powder had the following capacities: 4.50 ml/ gm, 75.73%, and 1.5 ml/ gm, respectively.

Table 2. Approximate chemical composition and functional properties of lyophilized taro mucilage

Parameters	Taro mucilage
Moisture (%)	6.45±0.15
Ash (%)	5.94±0.37
Proteins (%)	6.70±0.41
Crude fat (%)	0.52±0.27
Crude fiber (%)	2.37±0.12
Total Carbohydrates (%)	84.47±0.41
Functional characterization	
Swelling power %	11.32±0.44
water absorption (ml/ gm)	4.61±0.82
Emulsion Capacity %	76.14±1.72
oil absorption (ml/ gm)	1.59±0.35

***All data are the mean±SD of three replicates.**
****Calculated on dry weight basis as 100 – Ash + Protein + Fiber + Fat.**

Cake properties:

Proximate chemical composition and caloric value:

Table 3 provides information on the approximate chemical composition as well as the caloric content of cake produced with TM as a fat substitute. Results revealed that increasing of replacement, the cakes' contents of moisture, ash, proteins, crude fibre, and total carbohydrates all increased dramatically. Additionally, data in the same table demonstrated that prepared cakes with TM as a fat substitute had less fat content than these of control one.

Table 3. Proximate chemical composition and caloric value of prepared cake with taro mucilage as fat replacer

Parameters	control	Replacement level			
		TM-25%	TM-50%	TM-75%	TM-100%
Moisture (%)	19.41±0.89^{b}	19.81±0.66^{ab}	20.21±1.01^{a}	20.61±0.97^{a}	21.01±0.95^{a}
Ash (%)	2.56±0.21^{d}	2.90±0.05^{c}	3.72±0.39^{b}	4.09±0.37^{a}	4.46±0.44^{a}
Proteins (%)	5.82±0.36^{c}	6.23±0.38^{b}	6.64±0.42^{b}	7.05±0.39^{a}	7.47±0.47^{a}
Crude fat (%)	25.61±1.02^{a}	19.52±0.97^{b}	13.43±0.85^{b}	7.43±0.55^{c}	1.34±0.03^{d}
Crude fiber (%)	1.57±0.10^{c}	1.72±0.02^{b}	1.78±0.06^{b}	2.02±0.12^{a}	2.17±0.09^{a}
Total Carbohydrates (%)	45.03±0.79^{e}	49.82±0.63^{d}	54.22±0.90^{c}	58.8±0.96^{b}	63.55±1.01^{a}
Caloric value(Kcal/100g)	428.15	393.53	357.39	322.77	288.03

Values followed by different letters (a,b,c,d) in the same row differs significantly (P≤0.05).
***All data are the mean±SD of three replicates.**

The attained data were consistent with those attained by Nagata *et al.* (2015). The caloric content gradually decreased significantly as the amount of TM substituted rose, becoming more obvious at 100% (288.03 kcal) in comparison to control sample. 100% fat replacement level have 32.73% of calories were reduced. Felisberto *et al.* (2015) observed that the amount of chia mucilage utilised as the fat replacer at different levels resulted in a substantial (P≤0.05) reduction in the calories of cakes.

Physical and functional properties:

In Table (4), the physical characteristics of a cake prepared with TM in place of fat are listed. The final products' substitutes for TM did not substantially change pH values from the control. It varied from 7.12 to 7.33. The quantity of air that can be present in the finished product is indicated by the specific volume of the baked cake. A greater specific volume results from a stronger gas retention and product expansion (Ukom *et al.,* 2022). By increasing the degree of fat substitution with TM, the specific volume of the cake was reduced. The control sample had the greatest value, whereas the highest percentage of TM (100%) had the smallest value of specific volume. Cake sample TM 25%, which contains the least amount of TM, the least high specific volume. Also these results were similar to that of the control specimen, measuring 3.09 and 2.98cm3/g, respectively (Table 4).

More precisely, when the replacement level increased, the batter's viscosity reduced, reducing the amount of air bubbles that could be included during mixing and the amount of air that could be held throughout baking (Fernandes and de las Mercedes Salas-Mellado, 2017). Additionally, it was noted that the cakes' height decreased relative to the control when the taro mucilage percentage rose (to 25, 50, 75, and 100%).

Table 4. Physical characteristics of control cake and cakes prepared with taro mucilage as a fat replacer

Parameters	Control	Replacement level			
		TM-25%	TM-50%	TM-75%	TM-100%
pH	7.33^{a}	7.12^{a}	7.12^{a}	7.12^{a}	7.12^{a}
Specific volume (cm3/g)	3.09^{a}	2.98^{a}	2.76^{b}	2.54^{c}	2.48^{c}
Height (cm)	4.30^{a}	4.10^{a}	3.90^{ab}	3.50^{bc}	3.40^{c}
Crumb colour parameters					
L*	58.41^{b}	58.63^{b}	58.94^{b}	59.31^{a}	59.93^{a}
a*	9.84^{a}	9.70^{a}	9.62^{a}	9.35^{a}	9.00^{a}
b*	20.70^{a}	20.26^{a}	19.85^{ab}	19.42^{b}	18.89^{b}

Mean followed by different letters in the same row differs significantly (P≤0.05).

The colour of the crumbs is influenced by the components in the recipe, which is a key factor in how the cake looks (Akesowan, 2007). According to the information in Table (4), as the fat replacement % increased, L* values increased while a* and b* values decreased. The formulation with total fat replacement (TM-100) had significantly less lightness (L*) than the control formulation. Compared to the reference recipe, a lighter product was produced by substituting 25, 50, 75, and 100 g/100 g of fat. This behaviour is directly connected to the low value of L* for lyophilized TM. While parameter b* (yellowness) exhibited reduced values when there was higher TM incorporation, the smallest values were found in the recipe with total replacement of vegetable fat (TM-100). No statistical differences were seen for parameter a* (redness) alongside the fat reduction and TM increase. This variation in colour parameters might be attributed to the TM colour.

Texture:

For baked foods, texture is a crucial quality factor that might affect the sensory shelf-life. Cakes may lose their freshness and firm up while being stored, even in conditions that prevent moisture loss (Bedoya-Perales and Steel, 2014), most likely as a result of the migration of water, starch and protein interactions, and the retrogradation of starch (Ahmadi *et al.,* 2022). The impacts of fat removal must be carefully considered because fat is a component that improves product texture by making cakes softer for longer.

Table 5. Crumb hardness (g) of cakes throughout the storage period.

Storage time (day)	Control	Replacement level			
		TM-25%	TM-50%	TM-75%	TM-100%
0	104.76^{d}	119.34^{dc}	143.03^{bc}	168.75^{ab}	177.19^{a}
4	203.17^{d}	221.79^{dc}	236.74^{bc}	247.79^{ab}	265.88^{a}
8	251.42^{d}	260.45^{dc}	285.61^{bc}	296.17^{ab}	314.81^{a}

Mean followed by different letters in the same row differs significantly (P≤0.05).

Table 5 displays the results for cake hardness after storage at room temperature for 0, 4, and 8 days, which rose throughout the duration of the shelf-life. As the percentage of TM incorporation ascended to more than 25% replacement of fat, a considerable improvement in hardness was seen on every day of shelf-life. On day 1, however, TM-100 did not significantly differ from the control specimen, which was likely caused by the higher water content of TM-100. Cakes with TM fat substitution up to 25 % did not significantly differ from the reference sample in terms of the parameter stiffness till day 8.

The great ability of TM to hold water may be utilised for clarifying the behaviour of cake formulation TM-100, which might have had a favourable impact on the cake texture (raising softness). However, over the shelf-life of the product, this water evaporated, which accounts for the samples' increased hardness. The decrease in the amount of fat percentages in recipes TM-50 and TM-75 led to lesser aeration ability, worse structure of the cake crumb, and, as a result, a fewer soft cake crumbs and higher stiffness. Additionally, on day 8, there was significant variation between the TM-75 and TM-100 specimens and the control. This demonstrates that as time passed, it became clearer how important fat was in delaying crumb firming. The obtained results were in complete agreement with those obtained by Felisberto *et al.* (2015).

Sensory evaluation:

In the current investigation, Table (6) displays the sensory assessment of a cake incorporating TM powder with 0, 25, 50, 75, and 100% of control cake fat. According to the data in Table (6), there is a modest difference for all sensory attributes between the control specimen and those incorporating TM powder with proportions of 25%, 50%, 75%, and 100% of fat. According to data in the same table, cake prepared with 100% TM had the lowest values of sensory attributes (appearance, taste, crumb colour, odour , texture and total acceptability were 8.25, 8.00, 8.33, 8.27, 8.50 and 8.61, respectively) compared to the control sample, but they were still within acceptable bounds (greater than 6). In general, the sensory quality of every sample was good.

Table 6. Effect of taro mucilage powder percentage as a fat replacer on the sensory properties of cake*.

Sensory attributes	Control	Replacement level			
		TM-25%	TM-50%	TM-75%	TM-100%
Appearance	9.60±0.77^{a}	8.73±0.53^{b}	8.65±0.37^{b}	8.50±0.49^{b}	8.25±0.49^{c}
Taste	9.33±0.35^{a}	8.95±0.52^{a}	8.70±0.41^{b}	8.32±0.40^{c}	8.00±0.23^{d}
Colour	9.00±0.41^{a}	8.79±0.36^{b}	8.65±0.16^{b}	8.44±0.52^{c}	8.33±0.55^{c}
Odour	9.67±0.53^{a}	8.90±0.31^{b}	8.60±0.25^{c}	8.31±0.25^{d}	8.27±0.33^{d}
Texture	9.00±0.56^{a}	8.50±0.66^{b}	8.50±0.37^{b}	8.50±0.71^{b}	8.50±0.26^{b}
Total acceptability	9.52±0.49^{a}	8.67±0.92^{b}	8.89±0.30^{b}	8.73±0.12^{b}	8.61±0.23^{c}

***All data are the mean±SD of twenty replicates.**
Mean followed by different letters in the same row differs significantly (P≤0.05).

CONCLUSION

According to this study, taro mucilage (TM) is a novel component that can substituted fat in cakes. Results showed that TM was a successful fat substitute since formulations containing up to 25% fat replacement exhibited technical qualities equivalent to the control and kept them throughout storage. The major benefit of this component is that it allowed for the creation of cakes without the need for any additional ingredients or additions to provide for the fat reduction and to affect the physical properties of cakes. However, amounts beyond 25% of fat replacement should be carefully prepared since they may have a detrimental impact on the product's colour and texture. It is advised to conduct more research to see whether this innovative element may be used as a fat alternative in other baked products.

REFERENCES

AACC. (2010). Approved methods of the American Association of Cereal Chemists. St. Paul, MN: American Association of Cereal Chemists.

Ahmadi, F., Aghajani, N. and Gohari Ardabili, A. (2022). Response surface optimization of cupcake physicochemical and sensory attributes during storage period: Effect of apricot kernel flour addition. *Food Science & Nutrition*, 10, 661-677.

Akesowan, A. (2007). Effect of a konjac flour/soy protein isolate mixture on reduced-fat, added water chiffon cakes. *AU Journal of Technology*, 11, 23-27.

AOAC (2010). Official methods of analysis of AOAC international. Washington, DC: Association of Official Analytical Chemists.

Basiony, A., Atta, M., Abd-Elazim, E. and Mohamed, A. (2022). Chemical Composition and Functional Properties of Egyptian Taro (Colocasia esculenta) Mucilage. *Al-Azhar Journal of Agricultural Research*, 47, 185-1901.

Bedoya-Perales, N. S. and Steel, C. J. (2014). Effect of the concentrations of maltogenic α-amylase and fat on the technological and sensory quality of cakes. *Food Science and Technology*, 34, 760-766.

Bravo-Núñez, Á. and Gómez, M. (2021). Enrichment of cakes and cookies with pulse flours. A review. *Food Reviews International*, 1-19.

CAPMS (2019). Central Agency for Public Mobilization and Statics, issue February 2019 (ref no. 71- 22122- 2017).

Dadalı, C. and Elmacı, Y. (2020). Influence of Fat and Emulsifier Content on Volatile Release of Butter Aroma Used in Water Phase and Physical Attributes of Model Margarines. *European Journal of Lipid Science and Technology*, 122, 2000036.

Elsebaie, E. M. and Essa, R. Y. (2018). Microencapsulation of red onion peel polyphenols fractions by freeze drying technicality and its application in cake. *Journal of Food Processing and Preservation*, 42, e13654.

Essa, R. Y. and Elsebaie, E. M. (2022). New fat replacement agent comprised of gelatin and soluble dietary fibers derived from date seed powder in beef burger preparation. *LWT*, 156, 113051.

FAO (2008). Food and Agricultural Organization of United Nations. Publication report. Available at http://www.fao.org.

Felisberto, M. H. F., Wahanik, A. L., Gomes-Ruffi, C. R., Clerici, M. T. P. S., Chang, Y. K. & Steel, C. J. (2015). Use of chia (Salvia hispanica L.) mucilage gel to reduce fat in pound cakes. *LWT-Food Science and Technology*, 63, 1049-1055.

Fernandes, S. S. and de las Mercedes Salas-Mellado, M. (2017). Addition of chia seed mucilage for reduction of fat content in bread and cakes. *Food chemistry*, 227, 237-244.

Grundy, S. M. (2004). Obesity, metabolic syndrome, and cardiovascular disease. *The Journal of Clinical Endocrinology & Metabolism*, 89, 2595-2600.

Guiotto, E. N., Tomás, M. C. & Haros, C. M. (2020). Development of highly nutritional breads with by-products of chia (Salvia hispanica L.) seeds. *Foods*, 9, 819.

Manhivi, V. E., Venter, S., Amonsou, E. O. & Kudanga, T. (2018). Composition, thermal and rheological properties of polysaccharides from amadumbe (Colocasia esculenta) and cactus (Opuntia spp.). *Carbohydrate polymers*, 195, 163-169.

Miamoto, J. d. B. M., Pereira, J. & Bertolucci, S. K. V. (2018). Obtaining and characterization of freeze-dried whole taro root (Colocasia esculenta), mucilage and residue as functional food. *Nutrição Brasil*, 17, 9-18.

Nagata, C. L. P., Andrade, L. A. & Pereira, J. (2015). Optimization of taro mucilage and fat levels in sliced breads. *Journal of Food Science and Technology*, 52, 5890-5897.

Oladimeji, J. J., Kumar, P. L., Abe, A., Vetukuri, R. R. & Bhattacharjee, R. (2022). Taro in West Africa: Status, challenges, and opportunities. *Agronomy*, 12, 2094.

Pizarro, P. L., Almeida, E. L., Sammán, N. C. & Chang, Y. K. (2013). Evaluation of whole chia (Salvia hispanica L.) flour and hydrogenated vegetable fat in pound cake. *LWT-Food Science and Technology*, 54, 73-79.

Sanchez, C., Klopfenstein, C. F., & Walker, C. E. (1995). Use of carbohydrate-based fat substitutes and emulsifying agents in reduced-fat shortbread cookies. *Cereal Chemistry*, *72*(1), 25-29.

Shanta, S. S., Ahmed, T., Jubayer, M. F., Sharma, M., Sridhar, K., Hoque, M. M., Rana, M. R. & Inbaraj, B. S. (2023). Effect of Taro Corm Mucilage and Black Seed Oil as Edible Coatings on the Shelf-Life and Quality of Fresh Guava. *Agronomy*, 13, 538.

Syan, V., Kaur, J., Sharma, K., Patni, M., Rasane, P., Singh, J. & Bhadariya, V. (2022). An overview on the types, applications and health implications of fat replacers. *Journal of Food Science and Technology*, 1-12.

Therdthai, N. (2022). Sugar, salt and fat reduction of bakery products. In: Advances in Food and Nutrition Research. Pp. 283-327. Elsevier.

Tosif, M. M., Najda, A., Klepacka, J., Bains, A., Chawla, P., Kumar, A., Sharma, M., Sridhar, K., Gautam, S. P. & Kaushik, R. (2022). A concise review on taro mucilage: Extraction techniques, chemical composition, characterization, applications, and health attributes. *Polymers*, 14, 1163.

Ukom, A. N., Ezenwigbo, M. C. & Ugwuona, F. U. (2022). Grapefruit peel powder as a functional ingredient in cake production: Effect on the physicochemical properties, antioxidant activity and sensory acceptability of cakes during storage. *International Journal of Gastronomy and Food Science*, 28, 100517.

WHO (2017). World Health Organization : Obesity and overweight.

Yazar, G. & Rosell, C. M. (2022). Fat replacers in baked products: their impact on rheological properties and final product quality. *Critical Reviews in Food Science and Nutrition*, 1-24.

Zhang, W. & Huang, G. (2022). Preparation, structural characteristics, and application of taro polysaccharides in food. *Journal of the Science of Food and Agriculture*, 102, 6193-6201.

إعداد خلطة غير تقليدية للكيك منخفض السعرات بإستخدام ميوسيلاج القلقاس (*Colocasia esculenta*)

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الملخص

يهدف هذا البحث إلي إمكانية إستخدام مسحوق ميوسيلاج القلقاس كبديل للدهون في أحد منتجات المخابز (الكيك). في هذه الدراسة تم تقييم تأثير استبدال ٢٥ و ٥٠ و ٧٥ و ١٠٠٪ من الدهون بمسحوق ميوسيلاج القلقاس على الخصائص الكيميائية والفيزيائية والحسية للكيك. أظهرت النتائج أن التركيب الكيميائي للكيك المحتوي علي مسحوق ميوسيلاج القلقاس أظهر ارتفاعًا كبيرًا ($P \leq 0.05$) في محتوي الرطوبة مصحوبا بانخفاض كبير في محتوى الدهون كلما زادت نسبة الإستبدال بالميوسيلاج. كذلك كان هناك إنخفاضا في قيمة السعرات الحرارية بشكل ملحوظ بزيادة نسبة إستبدال الميوسيلاج بالدهن ، حيث انخفضت إلى ٣٢,٧٣٪ عند الاستبدال بـ ١٠٠٪. أيضا أظهرت النتائج أن هناك إنخفاضا في قيم الارتفاع والحجم النوعي للكيك المنتج بشكل كبير عند إستخدام الميوسيلاج كبديل للدهن بنسبة أعلى من ٢٥٪. كذلك أشارت النتائج إلي ارتفاع في قيم L * ، ولكن انخفضت قيم a * و b * مع زيادة نسبة استبدال الدهون. النسب المرتفعة من الإستبدال للدهون بـميوسيلاج القلقاس كان لها تأثير على صلابة فتات الكيك. وفقًا لنتائج التقييم الحسي لعينات الكيك كانت كل عينات الكيك المحتوية علي الميوسيلاج بالنسب المختلفة مقبولة من قبل المحكمين. وبذلك يمكن إستنتاج انه في حالة إستبدال ٢٥% من الدهن المستخدم في إعداد الكيك بمسحوق ميوسيلاج القلقاس فإنه لن يكون هناك أي تغييرات ملحوظة في الخصائص الفيزيائية والحسية للكيك الناتج.

الكلمات الدالة: كيك ، ميوسيلاج، القلقاس، منخفض الدهن