Evaluation of Cupcake Formulation by Replacement of Wheat Flour with Sugarcane Fibers

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Abstract

Egypt's sugarcane industry is one of the oldest, with plantations concentrated in Upper Egypt. Sugarcane is considered a strategic crop. This study aimed to maximize utilization of sugarcane by-products by incorporating sugarcane fiber (bagasse) into cupcake formulations, partially replacing wheat flour. The research evaluated chemical composition, total polyphenol content, microbial stability, functional properties including water-holding capacity (WHC), weight change, area, volume, color and sensory attributes of sugarcane bagasse powder. The bagasse underwent drying, milling, sieving, and sterilization to produce a fine powder. Proximate analysis revealed moisture, protein, fat, and ash contents of 4.22 ± 0.14%, 1.18 ± 0.02%, 0.98 ± 0.10%, and 2.35 ± 0.00%, respectively, with a WHC of 6.05 ± 1.56 g/g, demonstrating its potential as a low-fat, high-fiber ingredient with excellent water-binding capacity. The powder also exhibited high polyphenol content, indicating strong antioxidant activity. Microbiological tests showed that cupcakes fortified with sugarcane fiber had lower bacterial counts than controls. This may be due to the fiber's ability to bind water, reducing moisture availability for microbial growth. Color analysis indicated that replacing up to 25% of wheat flour with sugarcane fiber did not significantly affect product color ($P > 0.05$). However, higher substitution levels caused noticeable changes ($P < 0.05$), likely due to residual sugars and pigments in the bagasse that enhance crumb coloration and promote Maillard reactions during baking. Sensory evaluation showed improvements in overall acceptability, especially in color, for cupcakes enriched with sugarcane fiber compared to controls. These findings suggest sugarcane bagasse can be used in baked goods to improve nutritional value and sensory qualities without compromising quality.

Keywords: sugarcane bagasse; by-products; Functional properties; Water Holding Capacity WHC; Microbial stability

Introduction

By-products of agriculture constitute crucial sources of fiber and other essential bioactive substances, which are linked to health benefits when consumed regularly (**Lívia *et al.*, 2022)**. Sugarcane is a widely grown crop in tropical regions, with an annual global manufacturing of 1.91 billion tons. Sugarcane bagasse is a major byproduct of the sugar manufacturing process **(Dotaniya *et al.*, 2016).**

In addition to other health-promoting qualities like immune system stimulation and regulation, defense from hepatic damage, intestinal function rehabilitation, anti-thrombotic and anti-stress characteristics, growth stimulation, protection against DNA damage, and prevention of hypertension and diabetes disorders, sugarcane extracts have demonstrated antiproliferative activities against various cancer cell lines (leukemia, stomach, lung, colon, or bladder) ***(*Abbas *et al., 2014) ; (*Singh *et al., 2023).*** Sugarcane extracts have even been proposed as a safeguard radioprotector and free radical scavenger against free radical-producing chemicals, particularly those caused by exposure to radiation ***(*Kadam *et al., 2008).***

Fruit and vegetable byproducts from processing are often high in dietary fiber because of their water-binding characteristics. Comprehensive research has demonstrated that plant cell wall-derived dietary fibers can provide beneficial properties in food manufacturing such as gelling, thickening, and water binding. These advantageous features can be used in a variety of foods, including bakery, meat products, snacks, and diabetic beverages **Gidley and Yakubov, (2019).**

Dietary fiber (DF) is the major non-digestible (in the small intestine) fraction of cereal grains, fruits and vegetables and has been associated with nutritional and health benefits such as an improved blood lipid profile, glycemic control, diversity and activity of gut microbiota and alterations to rates of passage such as increased gastric retention time. These dietary fibers are widely recognized due to their high water-binding capacity (WBC) and nutritive value. As a result, sugarcane fiber (SCF) has attracted interest as a potential non-gluten dietary fiber source; however, there are no observations of its use in meat products **(Kim *et al.*, 2018).** Sugarcane is one of the most productive crops for generating fibrous material, which has been widely used for building purposes but remains underutilized in the food industry.

Sugarcane fiber (bagasse), the fibrous residue left after juice extraction from sugarcane, is increasingly recognized as a sustainable and multifunctional ingredient in the food industry. Traditionally utilized in bioenergy and packaging, recent studies highlight its potential in functional foods and dietary-fiber-enriched formulations. Sugarcane bagasse is rich in insoluble fiber (notably cellulose and hemicellulose) and phenolic compounds (ferulic, p-coumaric acids, quercetin derivatives), conferring benefits for digestive health, glycemic control, satiety, and antioxidant activity. These attributes make it a valuable ingredient for high-fiber food products **(Pérez-Contreras *et al.*, 2025)**

Sugarcane fiber (bagasse) is recognized for its high dietary fiber content and potential antioxidant properties, particularly after suitable processing or enzymatic treatment. Recent advances have explored its incorporation into food systems as a natural fiber enhancer, contributing to improved texture, water-holding capacity, and nutritional value. Moreover, the valorization of sugarcane bagasse supports sustainability efforts by promoting waste-to-value practices, aligning with circular economy principles and reducing environmental impact **(Gul and Riaz 2023).**

In food processing, sugarcane fiber has been successfully incorporated into bakery products, meat formulations, and dairy alternatives to enhance texture, water-holding capacity, and nutritional value, while also improving antioxidant properties. Additionally, its use in biodegradable food packaging materials reduces reliance on plastic, contributing to more eco-friendly supply chains **(Da Silva Junior *et al.*, 2024).**

The worldwide cupcake industry is distinguished by a diversified selection of sweet delicacies that appeal to a wide variety of consumers. According to Data Bridge Industry Research, the global cupcake industry is expected to grow rapidly from its 2023 valuation of USD 2.86 billion to USD 4.17 billion by 2031. "Classic Cupcake" dominates the cupcake market's product type category due to its timeless appeal, which includes traditional flavors like chocolate and vanilla, delivering a pleasant and nostalgic dessert experience. Their simplicity and widespread popularity make them suitable for numerous situations, appealing to a diverse customer base **(Data Bridge Market Research 2024).**

Therefore, the objective of this study is to assess the feasibility of utilizing sugarcane fiber (bagasse) as a functional ingredient in the development of high-fiber cupcakes

Materials and Methods

Materials

- Sugarcane bagasse fibers (SBF) were obtained from a local Sugarcane factory, Egypt.
- Wheat flour (refined), sugar, milk, egg, butter, and vanilla were obtained from the local market, Cairo, Egypt.
- All other chemicals, reagents, and solvents of proximal determination were obtained from El-Gomhoria Pharmaceutical Company, Cairo, Egypt.

Methods

Preparation of sugarcane fiber (bagasse):

Prior to usage, the traditional stainless- steel sugarcane mill roller and sugarcanes were washed, sanitized with a 5000-ppm sodium hypochlorite solution, and completely cleaned with potable water. The bagasse was dried in a convection oven at 55°C for around 12 hours until it reached a consistent weight. The SBF's particle size was subsequently reduced using a laboratory roller mill. The bagasse powder was put through a 40-mesh screen. The filtered powder had been sterilized at 121 °C for 20 minutes for microbial and enzymatic deactivation. After cooling, it was placed in HDPE bags, vacuum-sealed, and stored in refrigeration at 4 °C until use ***(Paixão et al., 2016)***

Cupcake -making procedure

Cupcakes were prepared based on a standardized cake premix formulation, following the method described by **(Purnomo *et al.*, 2012)** with slight modifications in ingredient quantities. The control sample (without additives) and other formulations were prepared using the same basic procedure. Initially, dry ingredients including wheat flour, sugar, baking powder, vanilla powder, and salt were thoroughly mixed in a mixing bowl. In a separate bowl, the wet ingredients whole milk, egg, and sunflower oil- were combined. The dry and wet mixtures were then blended together and mixed for 3 minutes at medium speed using an electric mixer. Approximately 50 grams of the resulting batter were poured into silicone cupcake molds, which were placed into metallic trays and baked in a preheated oven at 180 °C for 25 minutes.

Table (1): The formula for preparation of Cupcake

Ingredients	Control	T_1: (25%)	T_2: (50%)
Wheat flour. (g)	317	199	120
Sugarcane fiber bagasse. (g)	----	66	120
Sugar. (g)	159	133	120
Milk. (ml)	198	331	395
Oil. (ml)	79	66	60
Egg. (g)	222	185	168
Baking powder. (g)	19	16	14
Vanilla. (g)	5	4	4

T_1:(with 25% Sugarcane bagasse fiber), **T_2:**(with 50% Sugarcane bagasse fiber).
Note: The amount of milk was increased in T_1 and T_2 formulations to compensate for the high water absorption capacity of sugarcane bagasse fiber, which tends to absorb more moisture compared to wheat flour.

Photograph picture of cupcake fortified with sugarcane fiber (bagasse)

Determination of chemical composition of sugarcane bagasse fiber

Moisture, protein, fat and ash (by deference) were analyzed according to the methods described by **AOAC (2015).**

Determination of Total dietary fiber content

Total dietary fiber, cellulose, hemicellulose and lignin were determined according to the method by **AOAC (2012) and (Prosky *et al.*, 1992).**

Determination of phenolic compounds

The total amount of phenolic compounds of sugarcane bagasse fiber was measured by Folin method and the results were expressed in mg of gallic acid per gram of extract **(Rana *et al.*, 2014); (Sudha *et al.*, 2007).**

Objective evaluation of the final products

Change in weight (%) and area (cm^2):

Percent change of cupcake weight in the treated samples after baking was calculated (%). Cupcake areas were measured (cm^2) using a planimeter apparatus to determine cupcake uniformity upon the addition of sugarcane fiber (bagasse) against control according to **(Srilakshmi, 2003).**

$$\frac{weigt\ befor\ baking\ (g) - weight\ after\ bakig(g)}{weight\ before\ baking\ (g)}\ X\ 100$$

% weight change =

% area change =

$$\frac{area\ befor\ baking\ cm^2 - area\ afterbaking\ cm^2}{area\ befor\ baking\ cm^2}\ X\ 100$$

The cupcake volume (cm^3):

The volume of the cupcake was determined by the rapeseed displacement method using loaf volumeter 2 h after baking according to **(Penfield and Campbell, 1990).**

Color measurements

The cupcake color was measured using a colorimeter (color reader CR-10 Konica Minolta Sensing. Inc. INPUT: 8 V/9 V-1.5a), which was calibrated using a white and black standard plate. The Hunter tristimulus system was used for color determination, these parameters (CIE L* a* b*) indicate the following information: L* defines the lightness range from zero (black) to 100 (white); while a* and b* refer to green (a), red (+a), blue (b), and yellow (+b), respectively) **Li *et al.*, (2021).** The cake areas analyzed were the center, top, and bottom, with the aim of having a representative numerical value.

Water holding capacity (WHC)

The modified **(Gupta and Tiwari 2014),** approach was used to calculate the WHC of sugarcane fiber (bagasse) powder. In a centrifuge tube that had been previously weighed, 1.0 g of dried powder was suspended in 10 ml of distilled water at room temperature and vigorously agitated for five minutes. The inflated fiber particles were then collected from the supernatant and weighed after the combination was centrifuged for 30 minutes at 5,000 g. The weight (g) of water carried by 1 g of powdered sugarcane bagasse was used to calculate the WHC.

Total bacterial count

The total bacterial count was performed using the plate count agar medium as recommended by **FDA, (2002).**

Sensory evaluation of the final product

Sensory evaluation was performed using a score sheet to detect crust color, crump color, taste, odor, flavor, appearance, degree of chewing and overall acceptability. Organoleptic characteristics were evaluated from 1-5 degrees (1 represents very poor and 5 represents very good general acceptability) according to **(Penfield and Campbell, 1990).** Evaluation was carried out on 10 well-trained panelists (from the Home Economic Department, Faculty of Women for Arts, Science, and Education) using a score sheet. This evaluation test has been conducted according to ethical approval with the (Sci 1532408001) code number.

Statistical analysis

The statistical analysis was carried out using SAS statistical software for sensory evaluation of date products. The results were expressed as (mean ± SD). Data were analyzed by one-way analysis of variance (ANOVA). The differences between means were tested for significance using the least significant difference test (LSD) at ($P < 0.05$) **(SPSS, 1986).**

Results and Discussion

Chemical composition of sugarcane fiber (bagasse) powder

The chemical composition and total polyphenol content of sugarcane fiber (bagasse) powder on a dry weight basis are presented in **Table (2).** The moisture content was relatively low (4.22 ± 0.14%), which is favorable for extending shelf life and enhancing microbial stability during storage. The protein and fat contents were 1.18 ± 0.02 and 0.98 ± 0.10%, respectively, reflecting a modest contribution to the nutritional value of the powder. While these values are relatively low, they can still enhance the functional properties of food products when incorporated. The ash content (2.35 ± 0.00%) indicates the presence of mineral components. This suggests that sugarcane bagasse powder may contribute to the dietary intake of essential minerals when used as a food ingredient. The results indicated that bagasse powder contained a good content of total polyphenols, which are considered antioxidants and protect the body from free radicals **(Yuxi Lang *et al.*, 2024)** confirmed that the presence of bioactive compounds in sugarcane bagasse that may offer health-protective benefits.

Table (2): Chemical composition of sugarcane fiber (bagasse) powder (% dry weight basis)

Moisture	$4.22{\pm}0.14^{a}$
protein	$1.18{\pm}0.02^{c}$
Fat	$0.98{\pm}0.10^{d}$
Ash	$2.35{\pm}0.00^{b}$
Total Polyphenols (GAE*/g)	804.32± 0.04 µg

Values for texture profile analysis are means±SD; n=3, and means in the same column followed by different letters are significantly different (p<0.05).
*GAE: Gallic Acid Equivalent

The results presented in (**Table 3)** showed that sugarcane bagasse powder contained a total dietary fiber content of 9.22%. Among the fiber fractions, cellulose constituted the highest proportion (48%), followed by hemicellulose (30%) and lignin (20%). This composition reflects the typical structure of plant cell walls, where cellulose and hemicellulose contribute to bulk and water-holding capacity, while lignin adds structural rigidity. The high proportion of insoluble fibers suggests that sugarcane bagasse could serve as a valuable dietary fiber source in food formulations. These findings are consistent with those reported by **Ajala *et al.*, (2021),** who highlighted the high cellulose content that aids in facilitating digestion, supporting weight management, and regulating blood sugar levels. Additionally, sugarcane bagasse is considered biodegradable and environmentally friendly **(Sewell and Semenya, 2022).**

Table (3): Fiber composition of sugarcane fiber (bagasse) powder (% wet weight basis) (g/100g)

Total fiber	9.22
Cellulose	48
Hemicellulose	30
Lignin	20

Water holding capacity (WHC)

The water holding capacity (WHC) of sugarcane fiber powder was found to be 6.05 ± 1.56 g water/g dry powder (**Table 4).** This relatively high WHC indicates the fiber's strong ability to retain water, which can enhance the texture, mouthfeel, and juiciness of food products, especially in baked goods, meat analogues, and fiber-enriched formulations. High WHC is also advantageous for improving the functional and technological properties of food products, such as increasing yield, improving freshness, and reducing syneresis in gels or batters. Sugarcane bagasse exhibits significant water-binding capacity due to its high cellulose and hemicellulose content, making it a valuable ingredient in food product development **(Sangnark and Noomhorm, 2003).**

Table (4): Water holding capacity (WHC) of sugarcane fiber (bagasse) powder

Parameter	**Value (g water/g dry powder)**
Water Holding Capacity (WHC)	6.05±1.56 g of water/g of dry powder.

Total bacterial count of cake fortified with sugarcane fiber (bagasse)

Total bacterial count is considered one of the most important factors in the bakery industry, which represents the quality of bakery products. The bacterial count is primarily influenced by water availability; lower water levels result in greater control of bacterial content **(Noshirvani and**

Abolghasemi Fakhri 2024). The results presented in **Table (5)** indicate the bacterial count (log cfu/g sample) of cupcake samples enhanced with varying levels of sugarcane fiber (bagasse) during a 21-day storage period at room temperature. The findings demonstrate that the samples fortified with sugarcane fiber (bagasse) exhibited a lower bacterial count compared to the control sample. These results may be due to the high content of fiber and sugar, which had a great affinity to water and restricted its availability. These results agreed with **(Sherif El-Kadi *et al.*, 2018)**.

Table (5): Total bacterial count (log cfu /g sample) of cupcake samples fortified with different levels of sugarcane fiber (bagasse) during storage at room temperature for 21 days

Samples	Storage time (days)			
	zero	7	14	21
Control	1.91	1.99	2	2.85
T_1 (25%)	1.34	1.30	1.28	1.25
T_2 (50%)	1.38	1.11	1.09	1.02

T_1:(with 25% Sugarcane bagasse fiber), **T_2:**(with 50% Sugarcane bagasse fiber).

Color measurements of cupcake fortified with sugarcane fiber (bagasse)

Various sugarcane fiber flour contents were used to investigate the color as a physical parameter during the formulations. The results represented in **Table (6)** showed the color parameters for the control cupcake (wheat flour without additives) were L* (58.12 ± 1.06), a* (12.01 ±0.58) and b* (30.47 ± 0.48). The L* value increased from 58.12 ± 1.06 to 66.01± 0.58 (25 g kg-) as the amount of sugarcane fiber (bagasse) addition.

On the other hand, a* and b* decreased significantly with the amount of sugarcane fiber (bagasse) addition, indicating a remoteness for red and yellow color, respectively. Saturation slightly decreased as the proportion of bagasse increased, suggesting a reduction in color intensity or chroma, while hue angle remained relatively stable within the range of approximately 67–71, indicating consistency in the overall tone or hue of the cake color.

Mahmud and Anannya (2020), confirmed that the addition of sugarcane fiber (bagasse) to cupcake batters, substituting up to 25% of sugar with sugarcane powder did not significantly affect the cupcake's color compared to control samples. At higher substitution levels, noticeable color changes occurred ($P < 0.05$), indicating that moderate bagasse content can maintain or subtly enhance the natural color without adversely affecting appearance. Sugarcane bagasse contains residual sucrose and natural pigments, which, when incorporated at moderate levels, contribute to a richer, more visually appealing cake crumb. Additionally, its fiber content can improve browning reactions (Maillard effect) during baking, further enhancing color development.

Table (6): Color measurements of cupcake samples fortified with different levels of sugarcane fiber (bagasse)

Samples	L*	a*	b*	a/b	Saturation	Hue
Control	58.12 ± 1.06	12.01 ± 0.58	30.47 ± 0.48	0.394	32.75	68.49
T_1 (25%)	66.01± 0.58	11.52± 0.58	28.12± 0.12	0.410	30.39	67.72
T_2 (50%)	72.44± 0.58	9.48± 0.58	27.51± 0.08	0.345	29.10	70.99

T_1:(with 25% Sugarcane bagasse fiber), **T_2:**(with 50% Sugarcane bagasse fiber).

The physical properties of baked samples

The physical properties of baked samples were evaluated under different treatments, namely a control group and two experimental groups treated with 25% (Treatment A) and 50% (Treatment B) concentrations of an additive. The results in **Table (7)** were observed as follows:

Baking Time and Liquid Absorption

The control sample required 20 minutes for baking, whereas both Treatments A and B required slightly longer durations (20–25 minutes). This increase may be attributed to the higher water content used in the treated samples—250 mL and 300 mL for Treatments A and B, respectively, compared to 175 mL in the control. The increased water absorption capacity is consistent with previous findings that hydrocolloids or dietary fibers increase water retention and require longer baking times **(Rosell *et al.*, 2001; Collar *et al.*, 2007).**

Weight Before and After Baking

All samples started with the same pre-baking weight (815 g), but post-baking weights varied: 690 g (control), 756 g (T_1), and 780 g (T_2). This indicates reduced moisture loss in treated samples. The percentage weight loss was significantly lower in treated samples (7.2% for T_1 and 4.2% for T_2) than in the control (15.3%). This trend aligns with studies showing that fiber-enriched or hydrocolloid-containing products have improved moisture retention during baking **(Sudha *et al.*, 2007).**

Area and Volume After Baking

Treated samples showed larger surface areas: 26.8 cm² (T_1) and 27.9 cm² (T_2), compared to the control (24.7 cm²). Volumetric expansion also increased from 55 cm³ (control) to 60 cm³ (T_1) and 63 cm³ (T_2). These results suggest that the treatments improved gas retention and dough stability during baking, possibly due to changes in the gluten network and water-binding properties **(Gómez *et al.*, 2003).**

Height of the Samples:

The height of the samples also improved with treatments: 5.2 cm (control), 6.4 cm (T_1), and 6.8 cm (T_2), indicating better dough aeration and rise. These findings are in agreement with research indicating that certain additives can enhance dough elasticity and oven spring **(Majzoobi *et al.*, 2011).**

Table (7): The Physical properties of Cupcake at different levels of fortification by sugarcane fiber (bagasse)

Physical Properties	Samples		
	Control	T_1 (25 %)	T_2 (50 %)
Baking time (min)	20	20-25	20-25
Amount of liquid used for mixing (ml)	175	250	300
Wt. before baking (g)	815	815	815
Wt. after baking (g)	690	756	780
% change in wt. (gm)	15.3	7.2	4.2
Area After baking (cm2)	24.7	26.8	27.9
Volume (cm3)	55	60	63
Height (cm)	5.2	6.4	6.8

T_1:(with 25% Sugarcane bagasse fiber), **T_2:**(with 50% Sugarcane bagasse fiber).

Sensory evaluation of cupcake samples fortified with different levels of sugarcane fiber (bagasse)

Sensory evaluation scores of fortified cupcakes with different levels of sugarcane fiber (bagasse) were shown in **Figure (1).** Data showed that there are non-significant differences (P>0.05) among cupcake samples in appearance, flavor and color for all cupcake samples. Regarding taste acceptance, most of the tested samples were acceptable for the panelists, except the samples containing 50% of sugarcane bagasse. However, there were non-significant differences (P>0.05) between control cupcake samples and cupcake samples containing 25 and 50% sugarcane bagasse in both appearance, and flavor; the cupcake sample containing 25% of sugarcane bagasse had a positive effect on overall acceptability.

It could be concluded that the sugarcane bagasse showed strong effectiveness on the color properties of the cake samples when compared with the control samples. The scores of overall acceptability of cupcakes containing sugarcane bagasse at different concentrations were effective compared to control. However, cupcake sample containing 50% was less acceptable than the other samples in taste. Consequently, sugarcane bagasse could be used as natural flour additive in food, especially sugarcane bagasse containing high amount of fiber and can increase effects on human health.

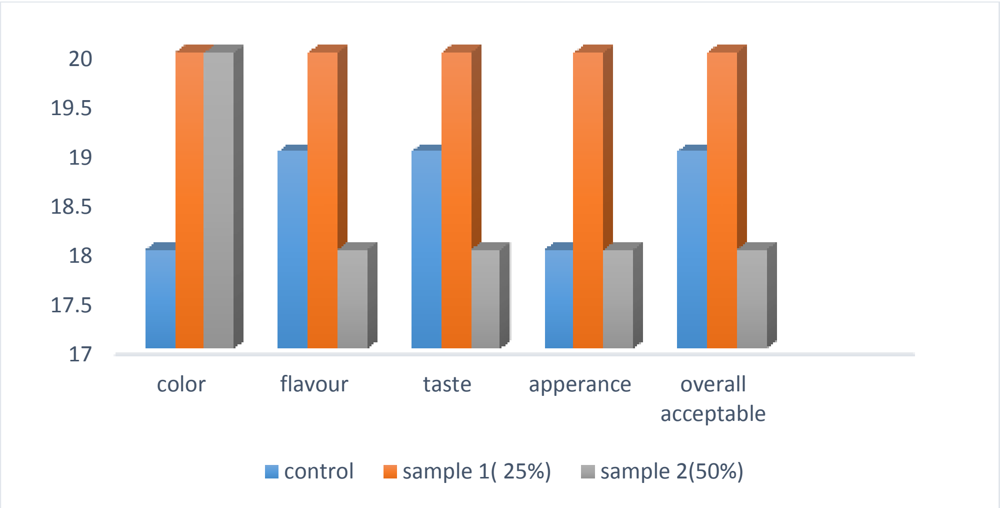

Fig.1. Sensory evaluation of cupcake samples fortified with different levels of sugarcane fiber (bagasse)

Conclusion

Sugarcane fiber (bagasse) powder proved to be a valuable functional ingredient with favorable chemical and functional properties, including high water holding capacity and antioxidant potential. Its incorporation into cupcakes improved microbial stability and enhanced sensory attributes particularly color at moderate substitution levels. These findings support its use as a natural, health-promoting additive in baked products without compromising quality.

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تقييم تركيبة الكب كيك عن طريق استبدال دقيق القمح بألياف قصب السكر

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المستخلص العربي

تُعد صناعة قصب السكر من أقدم الصناعات الزراعية في مصر، حيث تتركز زراعته في صعيد البلاد ويُعد من المحاصيل الاستراتيجية. هدفت هذه الدراسة إلى تعظيم الاستفادة من المنتجات الثانوية لقصب السكر من خلال إدخال أليافه (الباجاس) في تصنيع الكب كيك كبديل جزئي لدقيق القمح. تم تحليل التركيب الكيميائي، ومحتوى الفينولات الكلية، والثبات الميكروبي، والخواص الوظيفية مثل قدرة الاحتفاظ بالماء (WHC) والتغير في الوزن والمساحة والحجم واللون، بالإضافة إلى الخصائص الحسية لمسحوق الباجاس. تم تجفيف وتنعيم وتعقيم الباجاس للحصول على مسحوق ناعم. أظهرت النتائج أن محتوى الرطوبة والبروتين والدهون والرماد بلغ 4.22%، 1.18%، 0.98%، و2.35% على التوالي، بينما بلغت قدرة الاحتفاظ بالماء 6.05 جم/جم، مما يشير إلى ملاءمته كمكون منخفض الدهون وعالي الألياف. كما أظهر المسحوق نشاطًا مضادًا للأكسدة بفضل محتواه العالي من الفينولات. أوضحت التحاليل الميكروبية أن الكب كيك المدعّم بألياف القصب سجل أعدادًا بكتيرية أقل مقارنة بالعينة الضابطة، ويرجع ذلك إلى قدرة الألياف على امتصاص الماء وتقليل توفره للكائنات الحية الدقيقة. أظهرت تقييمات اللون أن استبدال دقيق القمح بنسبة تصل إلى 25% لم يؤثر معنويًا على لون المنتج، بينما أدت النسب الأعلى إلى تغيرات ملحوظة بسبب بقايا السكريات والصبغات الطبيعية. أشارت النتائج الحسية إلى تحسن في تقبّل اللون والمذاق. توضح هذه النتائج إمكانية استخدام ألياف قصب السكر في المنتجات المخبوزة لتحسين قيمتها الغذائية والجودة الحسية دون التأثير السلبي على جودة المنتج.

الكلمات المفتاحية: ألياف القصب – المنتجات الثانوية – الخصائص الوظيفية – القدرة على الاحتفاظ بالماء – الثبات الميكروبي.