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Enhancing Sensory Appeal and Consumer Acceptance of Cookies Through Fig-Based Natural Sweeteners

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ABSTRACT

Figs, known for their health benefits and mentioned in the Quran, are rich in natural sugars, fibres, vitamins, and minerals, making them ideal natural sweeteners for baked goods. This study investigates the use of fig powder and extract in cookie formulations, concentrating on sensory appeal and consumer acceptance in response to the growing demand from consumers for healthier options. A nine-point hedonic scale was used for sensory evaluation to analyse the effects of different quantities of fig powder and extract on sweetness, hardness, texture, taste, colour, and aroma compared to sample without figs. Results showed that cookies with higher fig concentrations generally received lower sensory ratings, particularly in sweetness and overall appeal. However, cookies with 6% fig extract closely resembled the control sample in sensory attributes and received better acceptance than those with higher concentration. The study concluded that lower concentrations of fig extract maintained desirable sensory qualities while offering a healthier alternative to refined sugar. The 6% fig extract formulation stood out as the most preferred, presenting potential for commercial success as a naturally sweetened cookie option.

1.0 Introduction

Recently, people were towards healthy lifestyle as people more aware of the importance of keeping good health. One of the most popular diets that people usually practice is cutting sugar intake and replacing sweeteners with more healthy sources. In this research, figs are used to reduce the use of sugar as a sweetener in food. Figs are known as one of the popular sunnah fruits apart from dates and raisins. Figs hold a special place in the hearts of the Muslim community, as they are mentioned in Surah At-Tin, the 95th chapter of the Quran. Only a handful of fruits are honoured with mentions in the Al-Quran, including olives, pomegranates, bananas, dates, and grapes (Kamarubahrin et al., 2020). Surah At-Tin, comprising eight verses and revealed in Medina, derives its name from the Arabic word for fig, 'At-Tin.' The chapter opens with the verse, "[I swear] by the fig and the olive." The Quranic expression of this oath by the olive and the fig highlights Allah's wisdom in disclosing the advantages of these fruits to humanity. This scriptural recognition has inspired extensive academic exploration of the fig's significance and benefits.

Apart from its religious and cultural significance, figs are celebrated for their delicious taste and various health benefits. Nutrient-dense figs can be used fresh or dried, as jams and juices, and for a variety of other purposes (Harzallah et al., 2016). They are one of the richest plant sources of calcium and fibre that stimulate digestion more efficiently than many other fruits and vegetables because of their strong antioxidant potential (Solomon et al., 2006) and abundance in vital vitamins, minerals, and dietary fibre (Joseph and Raj, 2011). Additionally, figs are also rich in easily digestible natural sugars, contributing to the regulation of cellular metabolic pathways (Solomon et al., 2006). Throughout history, figs have been used to treat a wide range of illnesses due to their putative antiviral, antibacterial, hypoglycemic, and anthelmintic properties (Jeong et al., 2005, Joseph and Raj, 2011).

Figs have a sweet taste and offer a healthier alternative to reduce sugar intake, especially in cookies products. Cookies are a popular treat enjoyed by people from all social classes thanks to the wide variety of flavours, textures, and how easy they are to digest. They make for a great, long-lasting snack and come in all sorts of shapes and tastes (Ismail et al., 2024). It is possible to use fig syrup in baked and cooked goods as a natural sweetener or sugar alternative. As consumer preferences shift towards healthier options, there is growing interest in utilizing natural ingredients like figs in food innovation, particularly in the cookie industry. Traditional cookies often contain high levels of refined sugars and artificial additives, prompting the exploration of fig-based alternatives. This research aims to investigate the effects of powdered and extracted figs on the sensory attributes and consumer acceptance of the cookies, offering insights for developing healthier and more appealing products aligned with current health trends.

2.0 Literature review

In recent years, the food industry has seen a significant shift towards reducing sugar intake due to associated health risks such as obesity and diabetes. This trend has prompted research into natural sweeteners as a viable alternative. Fig-based sweeteners offer potential due to their natural origin and associated health benefits, including being rich in fibre, antioxidants, and essential nutrients. They align with modern consumer preferences for healthy, functional products with clean labels that taste well (Saraiva et al., 2020).

One of the significant challenges in formulating cookies with natural sweeteners is maintaining the desirable sensory characteristics, such as sweetness, texture, and mouthfeel. Studies like those by Lee et al. (2021) show that complete replacement of sugar with natural sweeteners often results in undesirable flavours, such as bitterness, especially with high-intensity sweeteners like Rebaudioside A or well known as stevia. This has led to the common industry practice of partial sugar replacement, which tends to provide a more favourable sensory profile while still reducing sugar content. The Maillard reaction, which contributes to the browning and flavour of cookies, is also affected when sugar is replaced, making it essential for product developers to find a balance that maintains product quality (Saraiva et al., 2020).

The inclusion of fig-based sweeteners also introduces functional benefits such as the improvement of digestive health due to the high fibre content in figs. This aspect further enhances the appeal of cookies, particularly among health-conscious consumers. The natural sweetness and functional benefits provided by figs are also linked to sustainability, as natural ingredients are perceived as more environmentally friendly compared to synthetic sweeteners, aligning with increasing concerns about sustainability in food production (Saraiva et al., 2020).

The use of fig syrup as a sugar substitute in ice cream further supports its applicability in various food products. Janipour et al. (2023) found that partial replacement of sugar with fig syrup in probiotic ice cream improved the product's viscosity and maintained desirable sensory properties, suggesting that fig-based sweeteners could be successfully incorporated into diverse

formulations. This study highlights the potential of figs as not only a sweetening agent but also a functional ingredient in promoting gut health through the addition of probiotics.

In conclusion, fig-based natural sweeteners provide a healthier alternative to refined sugar in cookie production. However, achieving optimal sensory appeal and consumer acceptance requires careful consideration of the balance between sweetness, texture, and baking performance. As demonstrated in multiple studies, partial sugar replacement with fig-based sweeteners offers a promising solution that aligns with current consumer trends for healthier, more natural products.

3.0 Methodology

3.1 Ingredients

In developing fig cookies, seven distinct recipes were formulated using two primary methods: three recipes incorporated fig powder while another three employed extracted figs. Additionally, a classic cookie recipe devoid of fig additives was formulated as the control. Key ingredients comprised flour, sugar, butter, beaten eggs, baking powder and vanilla essence. Each recipe varied in the incorporation of fig powder and fig extract, using concentrations of 6%, 12%, and 18%. These differing levels facilitated a comprehensive evaluation to determine the optimal taste and texture of the cookies.

3.2 Preparation of Figs Powder

Fresh figs sourced from farmers' fields in Pagoh District, Johor are used to produce fig powder. Initially, the figs are washed, cleaned, and prepared by peeling the skin to reduce the bitterness and slicing it into thin sections to speed up drying process. The dehydration process was conducted in a cabinet dryer for about 9 hours at 60°C. Once thoroughly dehydrated, the figs were ground into a fine powder using a food grinder, with any excess lumps being strained out.

3.3 Preparation of Figs Extract

The extraction method used was the traditional water-water bath (w-wb) extraction technique. This method follows the procedure described by Lui et al. (2022), who compared various extraction techniques and identified the optimal process parameters for each by determining which method yielded the highest total flavonoid content. In this method, about 450 ml of water was added to a 500 ml conical flask containing 10g of powdered figs. The mixture was thoroughly stirred and heated in a water bath at 90°C for 70 minutes. After extraction, the mixture was filtered through a filter cloth to separate the precipitate. It was then allowed to cool for about 10 minutes before being transferred to a rotary evaporator. The rotary evaporator, set at 100 rpm and 80°C, was used to remove excess water and produce a concentrated extract, achieving the desired thickness in approximately 75 minutes.

3.4 Preparation of Figs Cookie

The production of fig cookies utilizes fig powder and fig extract, adhering to specific ingredient ratios as detailed in the formulations outlined in Table 1. The recipe adopts the methodology described by Khapre et al. (2015), with adjustments made to the quantities of fig powder to maintain them within desirable levels. Concentrations of 6%, 12%, and 18% of both fig powder and extract were mixed with butter, sugar, baking powder, and beaten eggs to form the dough. The dough was shaped into rectangular pieces and baked on a greased pan at 160°C for 10 to 15 minutes. According to Table 1, the total sweetening agents added to the cookies amounted to 40g. As the percentage of fig powder or fig extract increases, the amount of added sugar is reduced because the fig components contribute natural sweetness to the cookies.

Table 1: Recipe for preparation of fig powder and fig extract enriched Cookies.

Ingredients	Control	6% Figs Powder	12% Figs Powder	18% Figs Powder	6% Figs Extract	12% Figs Extract	18% Figs Extract
	%	%	%	%	%	%	%
1. Wheat Flour	49	49	49	49	49	49	49
2. Figs Powder	0	6	12	18	0	0	0
3. Figs Extract	0	0	0	0	6	12	18
4. Butter	20	20	20	20	20	20	20
5. Sugar	20	14	8	2	14	8	2
6. Beaten Eggs	10	10	10	10	10	10	10
7. Baking Powder	1	1	1	1	1	1	1
TOTAL	100%	100%	100%	100%	100%	100%	100%

3.5 Sensory evaluation

For a study on consumer acceptance, sixty semi-trained panellists from Politeknik Tun Syed Nasir Syed Ismail, comprising students of food technology, participated. Prior to the evaluation, the panellists received instructions on sensory testing and were provided with general information about the product. They assessed the sweetness, hardness, texture, taste, colour, aroma, and overall acceptability of four different cookie formulations using a nine-point scale. Both scoring tests and hedonic tests were conducted to gauge the acceptance of the fig cookies. Each panellist was served 7 formulated cookies, weighing approximately 15 grams each, at room temperature. The evaluation of all fig cookie samples was conducted in a single session, and water was available for rinsing between samples. The samples were anonymized using three-digit codes.

3.6 Consumer Acceptance

Consumer acceptance was assessed through hedonic testing, where panellists evaluated the attributes of sweetness, hardness, texture, taste, colour, aroma, and overall acceptability. This evaluation used a nine-point hedonic scale, with ratings ranging from 1, "Dislike Extremely," to 9, "Like Extremely." The Acceptability Index (AI) was calculated based on Equation [1], as outlined in the research conducted by Oliveira (2013 as cited Dutcosky, 2007).

$$\text{AI (\%)} = \frac{A\ x\ 100}{B} \quad [1]$$

where,
A = Overall Acceptance obtained for the product
B = Maximum grade given to the product

4.0 Discussion of analysis and findings

4.1 Scoring test

The scoring evaluation from Table 2 analyses several sensory attributes of cookie formulations using different concentrations of figs powder and extract, comparing them to a control sample. Each attribute of sweetness, hardness, taste, texture, colour, and aroma has been rated, with statistical significance indicated by letters (a, b, ab, etc.), where identical letters (e.g., 'a' and 'a') denote no significant difference ($p>0.05$) and differing letters (e.g., 'a' and 'b') indicate a significant difference ($p<0.05$).

Table 2: Significant Difference of Scoring Evaluation

Attributes	Control	6% Figs Powder	12% Figs Powder	18% Figs Powder	6% Figs Extract	12% Figs Extract	18% Figs Extract
Sweetness	5.07±1.230^{a}	4.13±1.279^{ab}	3.40±1.380^{b}	3.30±1.57^{b}	4.72±1.709^{a}	3.94±1.672^{ab}	3.97±1.628^{b}
Hardness	6.00±1.438^{a}	5.43±1.995^{a}	4.83±1.683^{a}	4.93±2.019^{a}	5.66±1.675^{a}	5.19±1.515^{a}	5.47±1.756^{a}
Taste	7.37±1.712^{a}	6.97±1.497^{ab}	5.93±1.72^{b}	5.93±1.639^{b}	7.00±1.464^{ab}	6.48±1.411^{ab}	6.40±1.567^{ab}
Texture	4.30±2.120^{a}	4.40±1.773^{a}	4.53±1.697^{a}	5.23±1.695^{a}	4.10±1.739^{a}	4.35±1.992^{a}	4.03±2.109^{a}
Colour	3.67±2.758^{ab}	4.33±1.373^{ab}	4.90±1.788^{ab}	5.27±2.083^{a}	3.34±2.468^{b}	3.39±2.362^{b}	3.47±2.389^{b}
Aroma	8.00±1.232^{a}	6.93±1.574^{abc}	6.43±1.716^{bc}	6.07±1.617^{c}	7.52±1.243^{ab}	6.52±1.630^{bc}	6.63±1.671^{bc}

Note: The means of two samples ± SE/SD are presented; ^{a,b,c} indicates significance of the difference between means at level of $p<0.05$

For sweetness, the control sample consistently scores higher (5.07 ± 1.230^{a}) compared to formulations with higher concentrations of figs, demonstrating a decline in perceived sweetness as the fig content increases. Notably, cookies with 6% Figs Powder (4.13 ± 1.279^{ab}) and 6% Figs Extract (4.72 ± 1.709^{a}) score relatively close to the control, indicating that lower concentrations of figs have a minimal impact on sweetness. Conversely, there is a significant decrease in sweetness for samples with higher concentrations of figs, such as 12% and 18% Figs Powder (3.40±1.380^{b} and 3.30±1.57^{b}) and 18% Figs Extract (3.97±1.628^{b}). This pattern underscores that increasing the fig content notably reduces the sweetness relative to the control, highlighting the impact of fig concentration on the sensory perception of sweetness in cookies.

Hardness scores across all cookie formulations are remarkably consistent, ranging from 4.83 to 6.00, which demonstrates that the addition of figs regardless of the form or concentration does not substantially affect the hardness of the cookies. Specifically, from the control (6.00±1.438^{a}) through to samples enhanced with 6% Figs Powder (5.43±1.995^{a}) and up to 18% Figs Extract (5.47±1.756^{a}), no significant differences in hardness are observed. This uniformity across the board indicates that the incorporation of figs, whether as powder or extract, does not alter the physical texture of the cookies in terms of their hardness.

In terms of taste, the control sample is consistently preferred, scoring the highest at 7.37 ± 1.712^{a}. However, there is a noticeable decline in taste scores for cookies with higher concentrations of fig powder, particularly at 12% and 18%, both registering lower scores of 5.93±1.72^{b} and 5.93±1.639^{b} respectively. This indicates a less favourable reception, likely due to the stronger influence of fig. On the other hand, the 6% Figs Extract maintains a comparably high score of 7.00 ± 1.464^{ab}, suggesting it is similarly palatable to the control. This consistency suggests that while lower concentrations of fig extract are well-received, higher concentrations of fig powder may significantly alter the taste, reducing its overall appeal.

Texture ratings across all cookie formulations are notably consistent, indicating that the addition of figs does not significantly impact the texture, regardless of concentration. For instance, the control sample scores a 4.30±2.120^{a}, and similarly, the 18% Figs Powder scores a slightly higher 5.23±1.695^{a}. This slight increase for the 18% Figs Powder might suggest a favourable structural change at this concentration, but overall, the variations are minimal. Such uniformity in texture scores across different concentrations and types of fig additions underscores the adaptability of figs in cookie recipes without markedly altering their textural properties.

Colour scores in the cookie formulations show a distinct pattern; they increase with the concentration of fig powder, indicating a more pronounced colour change as the fig powder content rises. For example, the colour score for the control is 3.67±2.758^{ab}, while the 18% Figs Powder, which is noticeably darker, scores higher at 5.27±2.083^{a}. On the other hand, formulations with figs extract, such as the 6% Figs Extract which scores 3.34±2.468^{b}, demonstrate no significant change in colour compared to the control. This suggests that while fig powder leads to a darker and more noticeable colour change in the cookies, fig extract has a minimal impact, maintaining colour scores comparable to the control and thus preserving the original cookie appearance.

Aroma evaluations across the different cookie formulations reveal that the control consistently registers the highest score at 8.00 ± 1.232[a], suggesting a baseline preference for the aroma of traditional cookies without fig additions. As the fig content increases, there is a general decline in aroma scores, with significant reductions noted particularly in cookies with higher concentrations, such as the 18% Figs Powder which scores 6.07±1.617[c]. However, the 6% Figs Extract stands out by closely matching the control with a score of 7.52 ± 1.243[ab], indicating that at this lower concentration, the impact on aroma is minimal. This suggests that while higher concentrations of figs diminish the aroma likely due to overriding natural scents, a lower concentration like 6% Figs Extract manages to retain much of the desirable aroma characteristics akin to the control.

In conclusion, the sensory evaluation of cookies with varying concentrations of figs reveals significant insights into the impact of fig content on consumer acceptance. Higher concentrations of figs generally result in lower sensory ratings, largely due to the introduction of stronger, less familiar flavours and aromas, which may not be as well-received. Conversely, cookies made with 6% Figs Extract exhibit sensory attributes that closely mirror those of the control, indicating high potential for consumer acceptance and underscoring the effectiveness of this formulation.

The statistical analysis supports these observations, highlighting that while lower concentrations of figs, particularly in extract form, retain sensory qualities akin to the control, higher concentrations significantly compromise key sensory attributes such as sweetness, taste, aroma, and overall acceptance. This analysis underscores the importance of carefully balancing fig content to enhance flavour without detracting from the desirable properties of the cookies. Ultimately, the optimal percentage of fig addition is crucial for maintaining the appealing sensory qualities of fig-enhanced baked goods, ensuring they meet consumer expectations and preferences.

4.2 Hedonic test

Analysing the hedonic evaluation data from Table 3 reveals how different concentrations of fig powder and extract influence various sensory attributes of cookies. The evaluation employed a nine-point hedonic scale where a score of 1 represents "Dislike Extremely" and 9 signifies "Like Extremely." This scale quantifies preferences across several sensory dimensions: sweetness, hardness, taste, texture, colour, aroma, and overall acceptance.

Table 3: Significant Difference of Hedonic Evaluation

Attributes	Control	6% (Powder)	12% (Powder)	18% (Powder)	6% (Extract)	12% (Extract)	18% (EXTRACT)
Sweetness	6.97±1.159[a]	6.20±1.324[abc]	5.80±1.349[bc]	5.30±1.343[c]	6.67±1.093[ab]	5.77±1.305[bc]	5.47±1.196[c]
Hardness	7.20±1.064[a]	6.50±1.167[abc]	6.07±1.285[bc]	5.80±1.297[c]	6.83±1.416[ab]	6.23±1.194[bc]	5.90±1.155[bc]
Taste	7.43±1.712[a]	6.63±1.402[abc]	6.13±1.408[bc]	5.73±1.437[c]	6.97±1.189[ab]	6.53±0.900[abc]	5.97±1.066[c]
Texture	7.17±1.117[a]	6.50±1.280[abc]	6.17±1.315[bc]	5.93±1.337[c]	6.87±1.074[ab]	6.33±0.959[abc]	6.00±1.203[bc]
Colour	7.43±1.135[a]	6.40±1.476[bc]	6.03±1.474[bc]	5.90±1.423[c]	6.97±0.999[ab]	6.37±0.999[bc]	6.13±1.042[bc]
Aroma	7.83±1.085[a]	6.93±1.337[bc]	6.30±1.236[bc]	6.23±1.006[bc]	7.10±1.213[ab]	6.60±1.037[bc]	6.13±1.074[bc]
Overall Acceptance	7.57±0.898[a]	6.70±1.236[bc]	6.27±1.388[bcd]	5.38±1.289[d]	6.97±1.033[ab]	6.47±0.900[bcd]	6.03±0.964[cd]

Note: The means ± SE/SD are presented; [a,b,c] indicates significance of the difference between means at level of $p<0.05$

Starting with sweetness, the control cookies score the highest at 6.97±1.159[a], suggesting they are much liked for their level of sweetness. As the concentration of figs increases, there is a noticeable decline in sweetness scores, with 18% fig powder and extract scoring significantly lower at 5.30±1.343[c] and 5.47±1.196[c], respectively, indicating less preference due to possibly overwhelming or unfamiliar fig flavours.

Hardness ratings also diminish as the fig content rises. The control, preferred for its ideal hardness, scores 7.20±1.064[a], whereas 18% concentrations in both powder and extract forms are

rated lower at 5.80±1.297[c] and 5.90±1.155[bc], reflecting a shift in texture that might not align with traditional cookie expectations.

In terms of taste, the control again leads with a score of 7.43±1.71[2a]. Higher concentrations of fig result in lower scores (5.73±1.437[c] for 18% powder and 5.97±1.066[c] for 18% extract), showing a significant deviation from the taste profile expected by consumers, potentially due to the stronger fig influence.

Texture scores closely follow this trend, with the control at 7.17±1.117[a]. An 18% fig powder sample scores the lowest at 5.93±1.337[c], suggesting that the incorporation of high levels of fig affects the cookie's structural qualities.

Colour changes are more pronounced with increased fig powder, leading to darker cookies. The control scores 7.43±1.135[a], whereas 18% fig powder registers at 5.90±1.423c, indicating a less favourable reception to the altered appearance.

Aroma evaluations favour the control at 7.83±1.085[a], with higher fig concentrations again showing a reduction in score, such as 6.23±1.006[bc] for 18% fig powder. This decrease may reflect a less appealing or overpowering fig scent compared to the traditional cookie aroma.

Lastly, Overall Acceptance sees the highest ratings for the control at 7.57±0.898[a], decreasing with higher fig additions. The 18% fig powder variant scores particularly low at 5.38±1.289[d], suggesting that as fig content increases, overall consumer satisfaction decreases.

The data from the hedonic evaluations illustrates a clear trend where increasing concentrations of figs, both in powder and extract forms, lead to lower sensory ratings across all attributes. Particularly notable is that cookies with lower concentrations of figs, such as 6% extract, tend to preserve sensory qualities similar to those of the control, making them more acceptable to consumers. This suggests that such lower concentrations closely match the sensory profiles of traditional cookies and are generally well-received.

However, significant differences are observed between the control and cookies with higher concentrations of figs, emphasizing the necessity of carefully balancing fig content to maintain desirable cookie properties. These results highlight that while minimal fig additions can enhance the product without drastically altering its characteristics, higher concentrations, especially of fig powder, significantly detract from sensory appeal. This leads to notable reductions in sweetness, aroma, and overall consumer acceptance.

Therefore, it is critical to find an optimal percentage of fig addition that preserves the traditional characteristics of cookies while introducing new flavours. The balance of fig content is crucial not only for sensory appeal but also for broad consumer acceptance, ensuring that the cookies remain enjoyable while benefiting from the natural sweetness and flavour of figs.

4.3 Consumer Acceptance

The Acceptability Index from Table 4 offers a crucial measure of consumer preferences, computed by averaging the overall acceptance scores across all cookie formulations. This index provides a clear indicator of how well each variant aligns with consumer tastes, especially in comparison to a traditional control. The control, which contains no fig additives, achieves the highest index at 84.11%, setting a robust benchmark for assessing the impact of fig additions.

Table 4: Acceptability Index of Hedonic Evaluation

Formulations	Acceptability Index %
Control	84.11
6% Figs Powder	74.44
12% Figs Powder	69.66
18% Figs Powder	59.77
6% Figs Extract	77.44
12% Figs Extract	71.88
18% Figs Extract	67.00

Cookies with 6% fig powder have an acceptability index of 74.44%, indicating a minor decline in preference but maintaining relatively high acceptance. As the concentration of fig powder increases to 12% and 18%, there is a more pronounced reduction in acceptance, with scores of 69.66% and 59.77%, respectively. These lower scores reflect a significant impact on sensory attributes, leading to decreased consumer satisfaction. According to Oliveira (2013 as cited Dutcosky, 2007), a product deemed acceptable in sensory attributes should achieve a minimum Acceptability Index (IA) score of 70%. Under this criterion, cookies with 12% and 18% fig powder fall below the threshold of acceptability.

Conversely, cookies enhanced with fig extract generally fare better in consumer evaluations. The 6% fig extract variation achieves a higher acceptability index of 77.44%, suggesting that fig extract is more palatable at this concentration than fig powder. Continuing this trend, 12% and 18% fig extract variations score 71.88% and 67%, respectively. Though these scores decrease with increasing concentrations, they remain higher than those of comparable fig powder concentrations and closer to meeting the acceptability threshold.

These insights underscore the importance of the form in which figs are added to products. The acceptability index, in this context, exclusively pertains to hedonic analysis, aiming to assess whether the product aligns with consumer preferences. The results clearly illustrate that while both forms of fig additions lead to a decrease in acceptability as their concentrations increase, the decline is more gradual with fig extract. This analysis is vital for product development, pointing to the need to carefully consider not only the quantity but also the form of fig additions to balance new flavours with maintaining consumer appeal.

5.0 Conclusion and Future Research

In conclusion, among all the tested formulations, cookies with 6% fig extract were the most preferred, striking a good balance between innovation and the familiar taste and texture of traditional cookies. This formulation closely aligns with consumer preferences and shows strong potential for commercial success. Future research could explore the nutritional profile of fig-based natural sweetener cookies compared to traditional cookies. This could highlight their benefits for health-conscious consumers, especially as fig extract offers a healthier alternative to refined sugar.

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Author Contributions

A.Z. Azmi contributed to the conceptualization, formal analysis, and drafting of the original manuscript. **M.H. Yahaya** was responsible for developing the methodology and contributed to reviewing and editing the manuscript. **N.E.A. Rohaizad** conducted the data curation efforts. **J. M. Azra** helped review and comment on the final manuscript**.** All authors have reviewed and approved the final version of the manuscript for publication.

Conflicts of Interest

The authors declare no conflict of interest.

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