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EFFECT OF WHEY PROTEIN ISOLATES AS FAT REPLACERS ON COOKIES AND IMPROVE THE HEALTH STATUS

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Abstract

Cookies are classified as biscuits "soft dough". There are many textural properties in cookies such as color, tenderness, and flavor but the most pronounced textural property is tenderness provided by the high-fat content (Zoulias et al,2000) ; Obeidat et al,2018). This study explained the effects of fat replacement with WPIs at different concentrations (0, 10, 20, 30, and 40%) on cookies regarding proximate analysis and sensory characteristics. The highest fat percentage was observed in Cookies (40%). The data revealed a significant increase in moisture content with increasing WPI in cookies. Moreover, the fat replacement WPI (1:1) reduced the fat contents of cookies and was directly proportional to the level of fat replacement. The samples subjected to WPI presented increased protein contents, which were directly proportional to the level of WPI added. There was no significant effect on cookie color at all WPI levels. Fat replacement with WPI had no significant effect on the softness or overall acceptability of cookies up to 20. In addition, WPI as a fat replacer had no significant effect on the flavor of cookies at any added level.

***Keywords**: Fat Replacers, Bakery Products, Whey Protein Isolate.*

1. INTRODUCTION

Cookies are classified as biscuits "soft dough". There are many textural properties in cookies such as color, tenderness, and flavor but the most pronounced textural property is tenderness provided by the high-fat content (Zoulias et al,2000); Obeidat et al,2018). This product is mostly prepared with flour 100%; margarine, 42.5%; granulated sugar, 25%; dry whole eggs, 5.28%; water, 4.9%3; vanilla flavoring, 1.00%; and salt, 1.25%.

The fat content of its products aids in performing texture, mouth feel overall smoothness, a tenderized product, a good taste, and a shorter dough (Ognean, et al., 2006). The interest in the correlation between food and health has increased in health and food processing fields (2007 Alonso, et al., 2005; Obeidat et al., 2024).

Fat, for example, is the most certain food component with a certain relationship with chronic diseases (Beunz et al., 2010). All efforts should be made to decrease the fat content of bakery products without affecting their sensory and quality properties (Seher and Sedat, 2016).

Fat substitutes are compounds that substitute fat with one or more functions based on carbohydrates, fat, and protein and are subdivided into 1-fat substitutes and 2-fat mimetics.

Fat substitutes are defined as large molecules that are likely triglyceride (TG) by physical and chemical properties and are added to replace fat with gram-to-gram or one-to-one bases, which are also stable at cooking and frying, whereas fat mimetics imitate triglyceride in characteristics such as organoleptic and physical characteristics but do not add as fat substitutes as a gram to gram or one-to-one bases, such as protein- or carbohydrate-based fat replacers, and the caloric value ranges from 0--4 kcal/g and

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is not stable at frying because it adsorbs water and/or denatures in caramelization (Akoh and Casimir, 1998; Lim, et al., 2010).

Whey protein isolate (WPI) is a high protein content produced by physical separation and concentration techniques from raw cow milk to isolate the minor basic whey protein lactoferrin, and lactoperoxidase has 90% protein or more, 6% moisture, 3.5% ash, 4.5% fat and 3% lactose with varying characteristics and can enter many products (Garba and Kaur, 2014; Ognean, et al., 2006; Morr and Ha, 1993).

WPIs are utilized as fat replacers in many products, such as infant formula, weight loss products, and food, for medical purposes to provide many functions, such as good emulsifying, fat-binding, gelling, whipping, and water-binding or thickening properties (Garba and Kaur, 2014; Ognean, et al., 2006; Morr and Ha, 1993).

When some ingredients are used in a product due to cost, allergies can be replaced with WPIs, such as eggs, and can result in the same properties, such as aeration in baked products such as muffins, cakes, and whips into mousses and toppings (Garba and Kaur, 2014; Ognean, et al., 2006; Morr and Ha, 1993).

The WPIs produced by these two methods include microfiltration and ion exchange, which produce products with different nonprotein contents, as ion exchange provides a relatively high level of beta-lactoglobulin and no glycomacropeptide (Garba and Kaur, 2014; Ognean, et al., 2006; Morr and Ha,1993).

2. MATERIALS AND METHODS

2.1. Materials

To produce cookies the following components were used:

Table 1: Materials used to produce cookies based on a percent weight of flour

Materials
flour 100
margarine 42.5
Granulated sugar 25
dry whole eggs, 5.28
water, 4.9
vanilla flavoring, 1.00
and salt, 1.25

2.2. Methods

The preparation of cookies based on Zoulias and his colleagues 2002:

1. Margarine, sugar, salt, and dry whole eggs were mixed in a mixer at low speed for 30 seconds, then increased to medium speed for 5 minutes to produce cream.
2. Add fat substitute with water at (1:3) at different percents (10,20,30, and 40%) as show in table
3. Mix the liquid ingredients with cream mixture at medium speed for 2 min.
4. Add the amount of sugar
5. Add flour and sodium bicarbonate to the mixture and mix at low speed for 15 seconds the mix at medium speed for 15 min.

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6. The dough was formed into biscuits.
7. Then baked for 20 minutes at 190 c in an air-circulating oven.
8. After two hours of cooling at room temperature, the samples were placed in PVC bags.

2.3. Replacement of fat in cookies with fat replacer (WPI)

Table 2: levels of fat replacers with WPI on cookies

Products	Treatments	Level of fat replacers
Cookies	1	0
	2	10
	3	20
	4	30
	5	40

Chemical Composition: the analysis of Protein, fat, ash, moisture, and carbohydrate was measured using approximate analysis based on AACC methods (AACC 2011).

2.4. Sensory evaluation:

Thirty-five people took part in the evaluation of consumer testing, which was conducted at two locations: Husun Colleges and The University of Jordan in Amman, Jordan. The test goals were communicated to the participants understandably.

Every panelist assessed every sample in the randomized complete block design that was employed. In each round, each customer assessed six distinct samples. Customers rate how much they like cookies. The first question on the 9-point verbal hedonic scale, which was labeled "dislike extremely" to "like extremely," asked participants to rate their general level of liking for the product's softness, flavor, and color.

2.5. Statistical analysis

To find any significant differences in the mean values, all of the measurements were examined using the SPSS software version 21 and analysis of variance (ANOVA) (Chysirichote, et al., 2011).

3. RESULTS AND DISCUSSION

3.1. Effect of fat replacement with WPIs on the chemical analysis of cookies:

As shown in Table 3, replacing whey protein isolate (fat replacer) with ratios of 10, 20, 30, and 40% in cookies instead of margarine resulted in a decrease in fat content in cookies by 12.3% and a decrease in energy content of 4.9%.

Additionally, a decrease in the energy content by 2.1 % was also observed. Table 3 also shows that the moisture content in Cookies is almost resemble control because whey protein isolates are characterized by high water vapor permeability (Kandasamy et al.,2021). These results are consistent with those of Sanger et al. (2022), who reported that the use of 10–40% fat replacers (whey protein and polydextrose) in biscuits reduces fat content and improves quality and organoleptic properties until 40% replacement.

Additionally, there was an increase in moisture content with increasing WPIs because of the highwater binding capacity of WPIs. These results are consistent with the results of Pimdit et al. (2008), who reported an increase in moisture content and a decrease in fat content when fat replacers (whey protein concentrate) were used in puff pastries.

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Table 3: Effects of whey protein isolates as fat replacements for sweet bakery products on proximate analysis

Sample WPI	Ash%	Moisture%	Fat%	Protein%	CHO%	Energy (KCAL)
cookies						
0	0.79 ± 0.00	10.4 ± 0.2	26.8 ± 0.6	6.1 ± 0.1	55.7±0.37	490
10	0.96 ± 0.05	11.0 ± 0.1	24.3 ± 0.5	7.2 ± 0.3	56.5 ± 0.7	473
20	0.92 ± 0.04	11.7±0.3	22.9 ± 0.4	8.8 ± 0.3	55.7 ± 1.1	464
30	0.90 ± 0.2	12.5±0.3	21.1 ± 0.6	10.7 ± 0.3	54.8 ± 1.1	451
40	0.88 ± 0.1	13.1 ± 0.2	18.4 ± 0.1	12.5 ± 0.3	55.1 ± 1.2	436
20	0.78 ± 0.08	2.7 ± 0.07	22.0 ± 0.5	7.0 ± 0.4	67.5 ± 0.9	496

*The values are the means of two replicates ± standard deviations.

3.2. Effects of fat replacement with WPIs at different concentrations on the sensory properties of cookies

The sensory assessment of the three confections in this investigation was carried out through consumer testing utilizing a composite score system. According to earlier research, food composites can be modified based on how similar they are to the control and how their sensory qualities are. One of the key elements that draw customers to a product or make them reject it is its color. As a result, the panelists chose the color of each treatment for these products, and Table 4 explains the mean ratings. Replacing fat at all levels has a negligible effect on the color of cookies. The softness scores of cookies are explained in Table 4. In cookies using WPIs as 20% fat replacement had no discernible effects on softness, it was related to the moisture-holding qualities of WPIs, which produced the same outcome without a difference (Serin and Sayar, 2016). These results are consistent with those of studies that investigated the impact of fat replacers (carbohydrate-based fat replacers) and created tougher goods, such as Grigelmo-Miguel et al. (2001), Khouryieh et al. (2005), Zahn et al. (2010), and Zoulias et al. (2002).

As was already mentioned, fat has the most palatable sensory qualities of all the ingredients in sweets and food products, and it tastes well in baked goods. Therefore, any modifications that lower the fat content of cookies will be met with less acceptability. Table 4 provides an explanation of cookies' overall taste and like scores. There were no significant differences in overall flavor found in any of the WPI-supplemented (control) samples of cookies. The flavor scores of the samples treated with fat replacers were 10, 20, 30, and 40% lower than those of the control samples. At every WPI, there was also a negligible variation in the flavor characteristics. The reason for the decline was food tastes becoming soluble in either lipids or water. However, as many fat-soluble flavors evaporate from the product when fat is replaced with WPIs in food, the flavor of the dish is diminished (Kaur and Sroan 2003). Furthermore, water-soluble taste components are retained longer when fat is substituted with WPIs. Up to 30% WPI, there was no discernible impact on cookies' overall acceptability.

Table 4: Effects of whey protein isolate on the sensory properties of Cookies

Product properties	Percent of fat replaced with WPI%				
	0	**10**	**20**	**30**	**40**
	Cookies				
Overall acceptance	6.80±1.97^{a}	7.41±1.56^{a}	7.09±1.63^{ab}	6.59±1.69^{ab}	6.13±2.01^{b}
Softness	7.17±1.60^{a}	7.18±1.42^{a}	6.88±1.54^{a}	5.77±1.54^{b}	5.84±1.83^{b}
Flavor	7.03±1.70^{a}	7.03±1.88^{a}	6.70±2.30^{a}	6.06±1.50^{a}	6.28±1.99^{a}
color	7.13±1.70^{a}	7.47±1.33^{ab}	7.09±1.57^{ab}	6.35±2.12^{ab}	6.97±1.86^{ab}

* Values within a row followed by a common letter are not significantly

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4. CONCLUSION

The maximum fat content that was replaced in Cookies was 40 % and the moisture content significantly increased with increasing WPI in cookies. Moreover, the fat replacement WPI (1:1) reduced the fat contents of cookies and was directly proportional to the level of fat replacement. The samples subjected to WPI presented increased protein contents, which were directly proportional to the level of WPI added. There was no significant effect on cookie color at all WPI levels. Fat replacement with WPI had no significant effect on the softness or overall acceptability of cookies up to 20 WPI, respectively. In addition, WPI as a fat replacer had no significant effect on the flavor of cookies at any added level:

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