Journal of Food Science and Technology (Iran)

Homepage: www.fsct.modares.ir

Scientific Research

The effect of adding apple peel powder on the physical and sensory properties of biscuits

Bushra Bader jerad Al- Shammari

Food Sciences Department, Agriculture College, University of Basrah, Basrah , Iraq

ARTICLE INFO

Article History:

Received: 2024/10/30
Accepted: 2024/12/1

Keywords:

Apple peels,
Chemical composition · biscuits,
spread ratio,
physical characteristics

DOI: **10.22034/FSCT.22.160.290.**

*Corresponding Author E-Mail:
bushra.jerad @ uobasrah ba.edu.iq

ABSTRACT

This study examined the viability of using APP as an initial raw material to make nutritional fiber powders and cakes targeted at those with diabetes. The investigation into using apple peel powder (APP) in biscuits. Apple peel powder was added to wheat flour at percentages of 1%, 2%, and 4% to make the biscuits. The sensory qualities and physical characteristics of the biscuits were examined. When the powder's chemical and water solubility index were 210±5.77350%, 216±12.01850%, and 0.34±.00577g/mL and 7.33±.66667%, composition was examined, apple powder had high values for its fiber, protein, and ash contents (13.66±.88192%, 3.03±.31798%, and 2.89±.67185, respectively). The functional qualities of the powdered apple peels showed that the peels' capacity to absorb water or oil respectively. The ability to absorb fat and water, as well as to biscuits' diameter, thickness, and spread ratio increased with the addition of apple peel powder, and the value increased with the degree of substitution. increase from 12.3333±.33333 to 13.5000±.28868 cm, 5.0300±.03512 to 5.3000±.05774 cm at level 2%APP, and 2.4333±.00882 to 2.6700±.00577 % at level 4%APP, respectively. The biscuits that had 1% APP had acceptableensory quality. According to this study, adding APP can result in fiber-rich cakes and bread with s superb texture qualities, low water content, and good sensory quality

1-Introduction

Most people consider biscuits to be among the most delectable baked goods, as they are leavened. Among bakery products, biscuits make up the largest group of snack items. These foods are steady and come with benefits such as being ready to eat, being widely consumed, having a long shelf life, and having good eating quality. Since practically all consumer types accept and consume biscuits in many different nations, they provide a useful vehicle for nutritional enhancement (Sadal *et al*., 2018).

These wastes represent a major environmental risk because of their great susceptibility to microbial deterioration. It is necessary to control and make useful use of the food waste.

Although Although fruit peels are usually thrown out into the environment as trash, they are a vital source of organic antioxidants. and ant nutrients due to the various phytochemicals present in them, just like in any other plant (Agbaje *et al., 2020*). A biscuit's nutritional quality and acceptability are enhanced by the presence of fiber, which can be achieved by varying the proportion of whole grains other than wheat in the raw ingredients or by adjusting the proportion of fiber in simple recipes. Apple fiber is mostly composed of carbohydrates and dietary fiber, with trace levels of protein, fat, and ash. It is produced from apple pulp (apple pomace) by drying and grinding it into a powder without any bleaching or refining. Additionally, apple fiber is a strong source of phytochemicals, particularly flavonoids and phenolic acids, which have been linked to antioxidant capabilities (Alsuhaibani, 2015).

Phenolic chemicals are abundant in apples; the total extractable phenolic content of fresh apples varies between 110 and 357 mg/100 g. It is well known that apples' peels have a significantly higher concentration of total phenolic chemicals than their flesh. Additionally, there are differences in the distribution and type of these phytochemicals between the apple's peel and flesh (Kelly *et al.,* 2003).

2-Materials and Methods

We bought yellow apples(*Malus domestica)*, wheat flour (72% extraction), and other supplies for making biscuits from a Basrah local store

Apple peel powder preparation.

To get rid of any superfluous foreign contaminants, the apple was first cleaned with tap water and then with distilled water. Using kitchen knives, the thoroughly cleaned fruit was peeled by hand. After being oven-dried for 72 hours at 37°C, the peels were milled into an acceptable powder (Agbaje et al., 2020).

Analyses of apple peel powder.

After oven drying to a constant weight at 105°C, the moisture content was measured.

The Kjeldahl method was used to measure the protein content of APP (N = 6).

, ash was measured two grams of each sample was put in a temperature-controlled furnace that had been warmed to 600 degrees Celsius. For two hours, the sample was kept at this temperature. This technique uses ether extraction followed by solvent evaporation to estimate the fat content of the APP. A

[DOI: 10.22034/FSCT.22.160.290]

percentage of the initial sample weight is used to express the fat content. The crude fiber content is then ascertained by filtering, washing, and drying the sample. A proportion of the initial sample weight is used to represent crude fiber. and carbohydrate contents were measured By difference, the total carbohydrate was obtained l.

Physico-chemical characteristics of apple peel powder

Bulk Density

A 10 mL tar-coated cylinder was gently filled with APP. Up until the sample level stopped changing, the cylinder's bottom was gently tapped against the surface. Bulk density (g/mL) was used to record the sample weight per unit volume (Weng *et al.*, 2020).

Water and oil absorption capacities

The Dhankhar *et al*. (2019) approach was used to evaluate the water and oil holding capacities. Each powder sample was precisely weighed (1 g) in a weighing dish, and it was then mixed with 10 ml (V1) of either refined vegetable oil or distilled water to create suspensions. After 30 minutes of aging, the suspensions were centrifuged for 10 minutes at 2200 g. supernatant was transferred into a 10 ml graduated cylinder following centrifugation, and volume was recorded as V2. The amount of water absorbed by the flour sample was represented as a percentage .

Water solubility index and swelling capacity

A method for figuring out a sample's swelling power was established by Dhankhar et al. (2019) using the water solubility index (WSI) and swelling capacity (SC). One gram of each flour sample was mixed with fifteen milliliters of distilled water and shook to create a suspension. After thatthe suspensions were maintained in an 80ºC water bath and centrifuged for 10 minutes at 3000 rpm.

SC = wt of sediment x 100/wt of powder −wt of dried solids in supernatent

Making biscuits

With a few minor adjustments, biscuits were made according to a standardized recipe (Dhankhar *et al., 2019*). The primary ingredient was wheat flour was mixed. at1%, 2%, and 4%, compared the control . To prepare the dough, wheat flour (100 g) and(3g) baking powder. It was combined with sugar 30g and 20 g fat , water 16 ml and then the necessary ,added the appropriate quantity of water to make the dough smooth. . The proportionate amount of sugar was replaced with date powder in the recipe for the partially substituted biscuits. The dough was formed into a circular shape with a diameter of 5 cm using a cutter after being smoothed out with a rolling pin to create a flat foundation with a thickness of 10 mm. The biscuits were baked for thirty minutes at

180°C in a laboratory oven. The biscuits were then removed from the oven, allowed to cool, and stored for further research in an airtight container. constant across all batches

Analytical physical

Three biscuits were arranged side by side and rotated ninety degrees to determine the diameter. After measuring the diameter (in

[DOI: 10.22034/FSCT.22.160.290]

centimeters) of three biscuits once more, the mean value was found. To measure thickness, three biscuits were stacked one on top of the other,. By splitting up dividing the average biscuit diameter by the average biscuit thickness, the spread ratio was found. (Dhankhar *et al., 2019).*

Sensory evaluation

Utilizing a nine-point hedonic rating system as per Dhankhar et al. (2019), a panel consisting of eight members from the Food Science Department in Iraq. individuals conducted sensory analysis of the biscuits. The biscuits', color, flavor , appearance, texture, and overall acceptability were all evaluated.

Analytical statistics

The results were statistically analyzed using a one-way analysis of variance (ANOVA) with three replications in a randomized block design. The program was used to perform the Least Significant Difference test (LSD) at $p<0.05$ The SPSS (2019) was used to do statistical analysis.

3-Results and Discussion

The proximate analysis of the apple peel powder .

The proximate analysis of the apple powder used in this investigation is compiled in Table 1. The apple peel powder had a higher quantity of fiber (13.66±.88192%), ash (2.89±.67185%), and a lower content of fat (2.57735%), protein (3.03±.31798), and carbohydrates (71.40%). These findings are lower than those of Agbaje et al. (2020), who had previously reported that apple peel contains 2.60% protein, 14% fiber, and 1.68 ash, respectively.

Table 2 : Proximate analysis of apple peels powder

properties	Amount%
Moisture	7±.57735
Protein	3.03±.31798
fat	2±.57735
ash	2.89±.67185
fiber	13.66±.88192
Carbohydrate	71.40±.67234

These findings concurred with those of Kamaljit *et al.* (2011) and Reis et al. (2012). The highest potential for integration in the bakery sector to produce high-fiber biscuits is found in the fiber content of apple peels. Apple peels contain between 14 and 30 percent crude fiber by dry weight.

[DOI: 10.22034/FSCT.22.160.290]

The study utilized apple peels that had significant dietary fiber and ash content. Every one of the APP's chemical properties agrees with findings from earlier research of a similar kind. Apple fiber, the main by-product of The apple juice industry is rich in cell wall material and an intriguing source of pectins. It has a greater total dietary fiber content than wheat and oat bran; therefore, it has good water-holding ability in some food products (Alsuhaibani,. 2015).

Physico-chemical parameters of apple peel powder

Table 4 displays APP's bulk density and functional characteristics. Apple peel powder had a bulk density of 0.34±.00577 g/ml, which is similar to values published by Alalor et al. (2014). the bulk density, which affects the quantity and strength of packing materials, energy density, texture, and mouthfeel (Udensi, 2006). The solubility value of apple peel powder was 54.33 ±2.96273%, which is consistent with the findings of Njintang et al. (2014), who stated that the mucilage's solubility was 60%.

Table 3 : Psycho-chemical parameters of apple peels powder

Physico -chemical parameters	values
Bulk density (g/ml)	0.34±.00577
water holding capacity%	210±5.77350
Oil holding capacity%	216±12.01850
water solubility index%	54.33 ±2.96273
Swelling capacity%	7.33±.66667

Additionally, the water and oil holding capacities were 210±5.77350 and 216±12.01850%, respectively. These values are completely consistent with the findings of Zaker *et al*. (2016), who reported that the water and oil absorption capacities of orange peel powder were 5.9 and 9.5 gram per gram, respectively. that, in comparison to the other attributes,

Foods with high OHC and WHC content can serve as useful ingredients. Adding components with a high water holding capacity can modify the viscosity and texture of prepared food; these modifications are attributed to the gelling, bulking, and thickening effects (Adriana and Man, 2014).. Conversely, substances with high OHC can function as emulsifiers and are crucial in stabilizing food systems with high fat content. APP's swelling power was 7.33±.66667%, which is lower than Adeyanju et al.'s published (2014) value of 9.50% of ipin (ficus elastica) gum. With the exception of bulk density and water solubility index, all examined characteristics showed

[DOI: 10.22034/FSCT.22.160.290]

higher values than those reported by *Dhankhar et al. (*2019).

Biscuits' physical characteristics

Table 1 shows the impact of different levels of apple peel powder incorporation on the biscuts' physical characteristics. The biscuits' diameter gradually increased as the level of proportion of APP increased, from 12.3333±.33333 for control without APP to 13.5000±.28868 in biscuits containing 2% APP. The potential cause of the diameter increase could be the APP's ability to bind water. As the proportion of APP in the flour blend increased, the biscuits' thickness and spread ratio gradually increased. This poor spreading was caused by the dough's high viscosity, which was brought on by the APP's absorption of water.

Ranjitha et al. (2018) showed comparable results. The authors' analysis revealed that adding 15 and 20% mango peel powder to biscuits resulted in a decrease in diameter and thickness. This could be because the powder diluted the gluten in the soft-dough biscuits.

Table 3 : The physical parameters of biscuits contain apple peels powder

levels	Diameter (cm)	Thickness(cm)	spread ratio(%)
T0	12.3333±.33333a	5.0300±.03512ab	2.4333±.00882a
T1	13.0000±.28868a	5.2000±.05774a	2.5167±.00882b
T2	13.5000±.28868b	5.3000±.05774a	2.5500±.00577c
T3	12.8300±.16503a	4.8267±.16344b	2.6700±.00577d

T0=control ,T1=1%APP,T2=2%APP,T3=4%APP

The results are a triplicate analysis average with ± standard deviation. A column's mean values that differ by a superscript indicate a significant difference ($p<0.05$).

This could be the result of improving the fruit and vegetable powder, which dramatically reduced the biscuit's thickness. It is ascribed to the addition of apple peel powder, which is a rich source of fiber, which increased the fiber content. The same pattern has been noted by Sharif et al. (2009) in de-fatted rice bran-supplemented cookies that are enhanced with fiber and minerals. When the amount of rice bran incorporated increased, they saw a tendency for the width to reduce, from 44.15 to 36.53 mm.

Sensory analysis of biscuits with powdered apple peels

Table 4 and Figure 1. show the sensory analysis of biscuits made with varying amounts of apple peel powder in comparison to the control biscuit. The results showed that, up to a concentration of 4%, adding apple peel powder to prepared biscuits significantly improved their color, flavor, appearance, and textural profile. However, at higher concentrations, these same characteristics were drastically

[DOI: 10.22034/FSCT.22.160.290]

reduced, including color, texture, flavor, and appearance. These findings concur with those of Sharoba *et al.* (2013).

Table 4 : sensory analysis of biscuits made with varying amounts of apple peel powder.

levels	flavor	color	appearance	texture	overall acceptability.
T0	8.1875±.22751a	8.3162±.21576a	7.6050±.35215a	7.8850±.38507a	7.9938±.14454a
T1	8.5825±.15051a	8.6337±.16804a	8.2513±.27721a	8.3913±.23803a	8.4600±.13148b
T2	7.9275±.13642a	8.1400±.05779a	7.9000±.19385a	6.3400±.42771b	7.5725±.12936a
T3	5.4850±.42198b	5.4300±.32232b	6.6275±.25222b	5.0550±.26807c	5.6450±.18548c

T0=control ,T1=1%APP,T2=2%APP,T3=4%APP

The results are a triplicate analysis average with ± standard deviation. A column's mean values that differ by a superscript indicate a significant difference ($p<0.05$).

results of the sensory calculation showed that the biscuit with 1% APP was the most desired option and received the highest rating for each of the sensory characteristics that were assessed, including flavor, color, appearance, texture, and overall acceptability. The 4% APP biscuit's color differed noticeably from the other samples. Additionally, compared to other samples, the 1% APP biscuit's flavor and texture were noticeably better, most likely as a result of the enhanced apple flavor.

0% 1% 2% 4%

The biscuits' texture score steadily increased as the amount of APP increased. The addition of APP gave the biscuits their distinctive apple flavor, which enhanced their flavor. biscuits kept a decent flavor even after adding 1%. Because of the formation of a distinct apple flavor, APP enhanced the biscuits' flavor. The biscuits' overall acceptability scores rose by 1% after the inclusion of APP, then fell. The sensory evaluations of the biscuits containing 4% APP were significantly lower. This alteration also takes place in the dough when APP is added. An excessively high hardness value, as that seen in the dough samples containing 4%APP, is

[DOI: 10.22034/FSCT.22.160.290]

not suitable for biscuits processing in real industrial production.

4-Conclusions

An underutilized by-product that is rich in nutritional fiber and can be used to make biscuits with lots of fiber is apple peels. The spread ratio of the biscuits was higher with the addition of APP. Because of their better flavor and taste, biscuits containing 1% APP were determined to have the most acceptable level of integration. Nevertheless, it was discovered that excessive levels of integration had a negative impact on the biscuits' texture, color, and appearance, which decreased their appeal overall. The addition of APP caused the biscuits' fiber content to rise. As a result, apple peel powder can be added to biscuits to enhance their fiber content. One of the key elements influencing food shelf life is moisture absorption or loss. Controlling moisture exchange is essential to avoiding enzymatic or microbiological spoiling.

5-References

[1] AACC. (2002). Official Methods of Analysis. 18th Edition, Association of Official Analytical Chemists, Arlington

[2] AOAC. (2010). Official Methods of Analysis. 18th Edition, Association of Official Analytical Chemists, Arlington.

[3] Sadal, K. B., Dabhade, S. B., & Bornare, D. T. (2018). Development and quality evaluation of pineapple pomace powder fortified biscuits. *International Journal of Chemical Studies*, *6*(4), 1019-1023.

[4] Agbaje, R. B., Ibrahim, T. A., & Raimi, O. T. (2020). Physico-chemical properties and sensory qualities of juices extracted from five selected fruits and their peels. *International Journal of Engineering Applied Sciences and Technology*, *4*(11), 2455-2143.

[5] Alsuhaibani, A. M. (2015). Biochemical and biological study of biscuit fortified with apple powder. *Middle East Journal of Agriculture Research*, *4*(04), 984-990.

[6] Dhankhar, J., Vashistha, N., & Sharma, A. (2019). Development of biscuits by partial substitution of refined wheat flour with chickpea flour and date powder. *The Journal of Microbiology, Biotechnology and Food Sciences*, *8*(4), 1093.

[7] Wolfe, K. L., & Liu, R. H. (2003). Apple peels as a value-added food ingredient. *Journal of Agricultural and Food Chemistry*, *51*(6), 1676-1683.

[8] Weng, M., Li, Y., Wu, L., Zheng, H., Lai, P., Tang, B., & Luo, X. (2020). Effects of passion fruit peel flour as a dietary fibre resource on biscuit quality. *Food Science and Technology*, *41*(1), 65-73.

[9] Păucean, A., & Man, S. (2014). Physico-chemical and sensory evaluations of wheat bread with pumpkin (Cucurbita maxima) pulp incorporated. *Journal of Agroalimentary Processes and Technologies*, *20*(1), 26-32.

[10] Kuntz, L. A., (1994) Fiber: from frustration to functionality.

[11] Food Product Design, *2*, 91-108.

[12] Sharif, M. K., Butt, M. S., Anjum, F. M., & Nawaz, H. (2009). Preparation of fiber and mineral enriched defatted rice bran supplemented cookies. *Pakistan Journal of Nutrition*, *8*(5), 571-577.

[13] Ranjitha, J., Bhuvaneshwari, G., Terdal, D., & Ganiger, V. M. (2018). Physico-chemical and sensory characteristics of pomegranate peel powder enriched defatted soy flour fortified cookies. *International Journal of Chemical Studies*, *6*(4), 1530-1536.

[DOI: 10.22034/FSCT.22.160.290]

[14] Udensi, E. A. (2006). Effects of fermentation and germination on the physicochemical properties of Mucuna cochinchinensis protein isolate. *African Journal of Biotechnology*, *5*(10), 896.

[15] Kamaljit, K., Amarjeet, K., & Pal, S. T. (2011). Analysis of ingredients, functionality, formulation optimization and shelf life evaluation of high fiber bread.

[16] Reis, S. F., Rai, D. K., & Abu-Ghannam, N. (2014). Apple pomace as a potential ingredient for the development of new functional foods. *International Journal of Food Science & Technology*, *49*(7), 1743-1750.

[17] Zaker, M. A., Sawate, A. R., Patil, B. M., & Sadawarte, S. K. (2016). Studies on effect of orange peel powder incorporation on physical, nutritional and sensorial quality of cookies. *International Journal of Engineering Research and Technology*, *7*(05), 2278-0181.

[18] Zaidan, U. H., Ghani, N. L. A., Zahari, N. S., Rahim, M. B. H. A., & Gani, S. S. A. (2021). Biofunctional characteristics of banana peel dietary fibre (BPDF) and its associated in vitro antidiabetic properties. *International Food Research Journal*, *28*(2).

[19] Adeyanju, O., Lajide, L., Ajayi, O. O., & Amoo, I. A. (2014). Research Article Morphological and Physicochemical Characterization of Ipin Gum (Ficus elastica). *Scholars Acad J Biosci*, *2*(11), 773-7.

[DOI: 10.22034/FSCT.22.160.290]