Effect of Adding Pineapple (*Ananas Comosus*) Pulp to the Sensory and Physicochemical Properties of Oat Flour Cookies

Norashikin Mohd Zain
Politeknik Tun Syed Nasir Syed Ismail, Johor
ashikin.zain@ptsn.edu.my

Siti Syazwana Md Ishak
Politeknik Tun Syed Nasir Syed Ismail, Johor
sitisyazwana@ptsn.edu.my

Muhammad Akmal Jelani
Politeknik Tun Syed Nasir Syed Ismail, Johor
m.akmaljelani@ptsn.edu.my

Abstract

This study aims to investigate the nutritional and dietary fibre potential of pineapple pulp (*Ananas comosus*) to deal with obesity issues in Malaysia. The objective of this study is to determine the sensory and physicochemical properties of pineapple cookies supplemented with four levels (control, 20%, 30%, and 40%) of pineapple pulp. The physical (hardness, springiness, cohesiveness, and adhesiveness) and chemical (moisture and crude fibre content) attributes were determined in the cookies. Increasing the level of substitution from 20% to 40% of pineapple pulp significantly ($p < 0.05$) increased the moisture and crude fibre content. The springiness, cohesiveness, and adhesiveness values of pineapple cookies increased with increasing pineapple pulp levels, while the hardness values of the samples exhibited the opposite pattern. Sensory evaluation showed that cookies with 40% pineapple pulp addition were the most well accepted.

Keywords: Cookies, sensory properties, physicochemical properties

1.0 Introduction

Over the past four decades, there has been a significant rise in the prevalence of obesity all over the world (Blüher, 2019; Chooi, Ding, & Magkos, 2019), with a particular emphasis on Asian and low-to-middle income countries (Blüher, 2019). Malaysia, a multinational country of primarily Muslims in Southeast Asia, has the highest prevalence of obesity in the area (World Health Organization, 2019), with the prevalence increasing from 15.1% in 2011 to 19.7% in 2019 (Institute for Public Health, 2019). Daily consumer demand for a healthy diet has increased as people have learned more about the nutritional value of food and how it can help them live a better life and lower their risk of chronic diseases (Hathwar, Rai, Modi, & Narayan, 2012; Jensen, Kesavan, & Johnson, 1992; Salleh, Noor, Mat, Yusof, & Mohamed, 2015). Therefore, the food industry has come under intense scrutiny in recent years due to the presumed connection that several processed products have with obesity. As a result of this scrutiny, there has been a growing interest in developing new products based on novel ingredients, which has been observed in recent years. The primary objective is to provide options for the general public that contribute to the upkeep of healthy lifestyles (Campo Vera, Lizcano Rojas, & Monroy Parra, 2016).

The term "functional food" refers to any food that, in addition to providing customers with the fundamental nutrients they need, can also provide additional health benefits. Increasing attention is being paid to functional bakery products to enhance consumers' overall health and well-being. A wide variety of functional food and drinks are available on the market, including functional beverages, bakery products, cereal-based foods, and dairy-based foods (Ninfali, Mari, Meli, Roselli, & Antonini, 2019). Cookies, a popular bakery product, have a high carbohydrate and fat content but low levels of fibre, vitamins, and minerals (Saly, Mohamed, Mona, & Amira, 2018). They are the most often consumed and typical type of baked good (Curutchet, Cozzano, Tárrega, & Arcia, 2019) and can be made into possibly functional cookies and other functional elements by adding cereals or fortifying them with cereals (Ganorkar & Jain, 2014; Gutierrez et al., 2017). They can also be supplemented with fruits (Aziz et al., 2020), making them more nutritious (Giuberti, Gallo, Fortunati, & Rossi, 2016; Wang, Li, & Gao, 2014). These approaches render the food a high nutritional value. Hence, when it comes to maintaining a healthy diet, consuming fortified or functionally improved foods can be of great benefit (López-Fernández et al., 2021).

This idea originated from the production of cookies that used grains like rice, barley, or oat in addition to fruits like banana, mango, guava, or pineapple (Singh, Riar, & Saxena, 2008). Fruits significantly impact human nutrition and health, particularly in the prevention and/or management of chronic diseases. This is mostly due to the high fibre and bioactive molecule content of fruits. The antioxidant, anti-inflammatory, and antithrombotic effects of phenols are essential (Macías-Cortés et al., 2020; Morais et al., 2015). Pineapple, scientifically known as *Ananas comosus*, is a tropical fruit prized for its singular flavour and naturally sweet scent. Because it contains several volatile chemicals in small amounts and complicated mixes, it has a well-deserved reputation for being a fruit with a strong flavour. In addition, pineapple is a good source of minerals and vitamins associated with various positive health effects. The international market has seen a significant rise in pineapple demand, which now ranks third behind banana and citrus fruits in popularity. The pineapple sector has been expanding rapidly worldwide in terms of utilising food-based processing goods based on pineapple and waste processing. Pineapple is nothing short of beneficial elements, including bioactive chemicals, dietary fibre, minerals, and other essential nutrients. In addition, research has shown that pineapple offers an assortment of health benefits, including anti-inflammatory properties, antioxidant activity, the ability to monitor and heal bowel movement, and monitoring the performance of the nervous system. The potential for pineapples to be processed into food goods, as well as waste products, is also emphasised. Pineapples offer several advantages to one's health and could represent a significant development in the agricultural and food processing industries (Mohd Ali, Hashim, Abd Aziz, & Lasekan, 2020).

Products made with oats have risen in popularity due to their perceived health benefits (Kaur, Kaur, Basha, & Kennedy, 2022; Mao et al., 2022). Oats, scientifically known as Avena sativa, are a cereal from the Poaceae family. As a result of the comparatively large amounts of protein, fibre (Mousa, El-Saadani, El- Mansy, Abd El-Salam, & Morsy, 2022), vitamin B, and minerals it contains, it exerts beneficial nutritional properties (Sterna, Zute, & Brunava, 2016). The soluble glucan, a heterogeneous group of non-starch polysaccharides, is the most significant fibre found in oats. Numerous studies have shown that this type of fibre positively affects diseases such as obesity, diabetes mellitus, hypertension, and dyslipidaemia, to name just a few of the conditions that have been investigated (El Khoury, Cuda, Luhovyy, & Anderson, 2011).

Pineapple pulp and oats have positive qualities as food ingredients, and combining them in oat cookies could be an effective strategy to introduce new pineapple-containing items to the market. The sensory and physicochemical properties of oat flour cookies enriched with pineapple pulp are the focus of this research project.

2.0 Materials and Methods

The ingredients for the cookies were procured from the 99 Speedmart store in Pagoh, Johor. These included whole rolled oats flour, oat flour (fine), butter, white sugar, brown sugar, salt, and baking soda (sodium bicarbonate). Raw Sarawak pineapples (*A. comosus*), with a maturity index of 4, were purchased from the Wetex Mall in Muar, Johor.

The pineapple pulp extract was made using the technique described by Rosnah, Coskan, Wan Ramli, Mohd Sobri, & Osman (2011). The fresh Sarawak pineapple was given a quick rinse under running water to remove any remaining grit. After washing, the pineapple was peeled by hand using a sharp knife. The juice was squeezed out of the raw pineapples by hand using a muslin cloth. The pineapple pulps from Figure 1 were placed in polythene bags in the chiller at 4 °C.

Figure 1: Pineapple pulp

The cookie samples were prepared based on the oat flour (coarse) replaced by pineapple pulp at different levels (60%, 40%; 70%, 30%; 80%, 20%; and 100%, 0%), as shown in Table 1. Butter, white sugar, brown sugar, salt, and baking soda were added and beaten for 6 min in a mixer (Kenwood kitchen mixer, model KVC3100s/w, United Kingdom) to obtain a creamy texture. Next, the eggs were beaten and added to the mixture based on the flour content before kneading and forming the mixture into a dough. The dough was moulded into standard shapes and placed on the baking sheet. The weight of the shaped dough was determined prior to baking. The dough was baked at 150 °C for 15 min in a vertical oven (Ineo, model BK-SCO5-E, China). After baking, the cookie samples were allowed to cool at room temperature and placed in polyethylene bags that had been hermetically sealed before being stored until the analysis.

Table 1: Formulation of oat flour (coarse) cookies added with different percentages of pineapple (*Ananas comosus)* pulp

Ingredients (g)	Formulations (%)			
	F1	F2	F3	C
	(60%:40%)	(70%:30%)	(80%:20%)	(100%:0%)
Pineapple pulp	17.9	13.4	8.9	-
Oat flour (coarse)	26.8	31.3	35.8	44.7
Oat flour (fine)	5.8	5.8	5.8	5.8
Butter	14.7	14.7	14.7	14.7
White sugar	13.0	13.0	13.0	13.0
Brown sugar	13.0	13.0	13.0	13.0
Egg	8.4	8.4	8.4	8.4
Salt	0.2	0.2	0.2	0.2
Baking soda	0.2	0.2	0.2	0.2

C (control) = 100% Oat flour (coarse), F1 = 60% Oat flour (coarse) + 40% Pineapple pulp, F2 = 70% Oat flour (coarse) + 30% Pineapple pulp, F3 = 80% Oat flour (coarse) + 20% Pineapple pulp

The hedonic test was conducted to evaluate the degree that the pineapple cookies were liked overall. The sensory evaluation tests were conducted according to Dan et al. (2015), where 60 untrained panellists comprising Diploma in Food Technology semester 5 students from Politeknik Tun Syed Nasir Syed Ismail, Johor, were asked to rate four samples based on the degree of liking on a five-point hedonic scale (1 = dislike extremely, 2 = dislike slightly, 3 = neither like nor dislike, 4 = like slightly, 5 = like extremely). The panellists were asked to indicate their level of acceptance in the five-point hedonic scale questionnaire, comprising texture, colour, flavour, aroma, and overall acceptance. The samples were placed on plates and identified with random three-digit numbers. The panellists evaluated the four samples in a testing area and were asked to rinse their mouths with water between samples to avoid any residual effects.

The AOAC (2000) method was used to determine the moisture and crude fibre content levels. A texture analyser (Brookfield Texture Analyzer, model CT310K, USA) was used to measure the texture profile of biscuits in terms of hardness (g), cohesiveness, springiness (mm) and adhesiveness (mJ). The studies were performed at standard room temperatures and humidity levels. Every measurement was performed in triplicate, except for the sensory analysis, which had a total sample size of sixty. A statistical analysis programme was used to assess the analysis of variance (ANOVA) on the experimental data, and the experimental design was completely random (SPSS Statistics 26). The level of 0.05 was employed in Duncan's multiple range tests to establish the significance of the difference between the means.

3.0 Results and discussion

The hedonic scale is a unique scale that provides dependable and valid results when used to measure a consumer's liking and preference for a particular product (Stone, Bleibaum, & Thomas, 2012). The results from the untrained panellists reported statistically significant changes in texture, colour, flavour, aroma, and overall acceptance scores between the control, 40%, 30%, and 20% of pineapple pulp. These differences were identified in the colour, flavour, aroma, and overall acceptance scores (Table 2). The findings indicated that cookies made with a mixture of 40% pineapple pulp and 60% oat flour (coarse) were well received, as denoted by the highest score in colour, flavour, aroma, and overall acceptance of the cookie. The volatile content of pineapple, which mainly influences the sensory notes of fruit flavours, may account for the observed difference. Pineapple's wide range of varieties and flavour profiles provide valuable data for ongoing studies of fruit fragrances and serve as selling points for the product (Lasekan & Abbas, 2012). The effectiveness of fragrance-active substances is, in this context, influenced by aroma threshold, concentration, interaction with other compounds, and volatility (Zhang, Cao, & Liu, 2019).

Table 2: Sensory evaluation of pineapple cookies

Samples	Texture	Colour	Flavour	Aroma	Overall acceptance
C	2.43 ± 0.81^{b}	3.07 ± 0.55^{b}	3.58 ± 0.70^{c}	3.07 ± 1.12^{b}	3.52 ± 1.00^{c}
F1	4.17 ± 0.99^{a}	4.15 ± 1.12^{a}	4.63 ± 0.69^{a}	4.72 ± 0.64^{a}	4.83 ± 0.49^{a}
F2	2.42 ± 0.91^{b}	3.07 ± 0.55^{b}	3.27 ± 0.66^{d}	2.33 ± 0.90^{c}	2.72 ± 0.61^{a}
F3	4.17 ± 0.99^{a}	3.95 ± 1.08^{a}	4.15 ± 1.12^{b}	4.72 ± 0.64^{a}	4.08 ± 0.96^{b}

C (control) = 100% Oat flour (coarse), F1 = 60% Oat flour (coarse) + 40% Pineapple pulp, F2 = 70% Oat flour (coarse) + 30% Pineapple pulp, F3 = 80% Oat flour (coarse) + 20% Pineapple pulp. Five-point hedonic scale (1 = dislike extremely, 2 = dislike slightly, 3 = neither like nor dislike, 4 = like slightly, 5 = like extremely), respectively. The significant differences (p < 0.05) between means represented by different letters within columns.

Cookies depicted in Figure 2 were prepared using the different formulations provided in Table 1. The results obtained for moisture and crude fibre content analysis of cookies incorporated with different proportions of oat flour and pineapple pulp are depicted in Table 3. The results of each test, including the average and the standard deviation, represent triplicate experiments. Moisture content in the cookies was significantly ($p < 0.05$) increased as the amount of pineapple pulp replaced increased (3.70%, 6.36%, and 6.51% for F3, F2, and F1). However, the highest moisture content is still within the low range for foods. The low moisture content of the cookies prevents alterations in their qualities, as well as deterioration caused by the growth of microorganisms. Additionally, reduced moisture values result in increased shelf life and easier transportation and storage (López-Fernández et al., 2021).

The crude fibre content in the cookies was also significantly ($p < 0.05$) increased due to the addition of pineapple pulp. This was attributed to the higher crude fibre content in pineapple pulp. The pineapple pulp is an excellent source of crude fibre (Ackom & Tano-Debrah, 2012). The study revealed that 12.50% and 29.86% of crude fibre content were found in unprocessed pulp and processed pulp.

F1 F2 F3 C

Figure 2: Pineapple cookies

Table 3: Proximate Analysis of pineapple cookies

Samples	Moisture (%)	Crude fibre (%)
C	2.24 ± 0.41^{b}	1.84 ± 0.97^{b}
F1	6.51 ± 1.28^{a}	3.58 ± 0.55^{a}
F2	6.36 ± 1.24^{a}	3.29 ± 0.28^{a}
F3	3.70 ± 0.48^{b}	2.93 ± 0.03^{ab}

C (control) = 100% Oat flour (coarse), F1 = 60% Oat flour (coarse) + 40% Pineapple pulp, F2 = 70% Oat flour (coarse) + 30% Pineapple pulp, F3 = 80% Oat flour (coarse) + 20% Pineapple pulp. The significant differences ($p < 0.05$) between means represented by different letters within columns.

The results obtained for the texture analysis of cookies are presented in Table 4. The results showed that adding pineapple pulp reduced the hardness and increased springiness, cohesiveness, and adhesiveness of the cookies. Hardness is a textural property that attracts significant attention in the evaluation of baked goods because of its close association with the human perception of freshness. Hence, the lower possible value of this parameter is desirable (Aziz et al., 2020; Li et al., 2020). The hardness of biscuits is defined by protein aggregates, lipids, and sugars embedded in ungelatinised starch granules (Chevallier, Colonna, Buléon, & Valle, 2000). The taste of the cookies will be affected if the hardness is too high, and the cookies will not be crisp enough. In contrast, cookies with an insufficient amount of hardness will break easily. The softness of the cookies can be attributed to the lessened gluten network structure within them (Jia et al., 2020). In the meantime, due to the high water-holding capacity of pineapple pulp, the cookies could retain more moisture than they would have otherwise, leading to a reduced hardness level of the cookies.

"Cohesiveness" refers to the amount of internal binding force necessary to create a sample. This force reflects how strongly molecules inside the sample interact with one another or the various structural parts. Therefore, it indicates not only the ability of the sample to keep its integrity but also its resistance to being damaged (Jia et al., 2020). The cookies' cohesiveness was increased due to the increased pineapple pulp percentage. The cohesiveness of food indicates the strength of the internal bonds that bind the food particles together and indicates how well a biscuit can sustain a second deformation compared to its resistance under the initial deformation. If the cohesiveness value is high, the biscuit will have a stronger tendency to break when put under pressure (Bakare et al., 2020).

Although there are a few different techniques to assess springiness, the most frequently used method is the distance of the detected height (hardness) during the second compression divided by the distance of the initial compression. It provides an organoleptic representation of how well a product physically recovers after being distorted during the first compression and then being allowed to wait for the target wait time between strokes (Bakare et al., 2020). Adhesiveness indicates the degree to which products are sticky. The effort is necessary to overcome the adhesive forces between the sample and the probe (Trinh & Glasgow, 2012). The texture profile study revealed that the springiness and adhesiveness of the pineapple cookies increased slightly with the increasing levels of pineapple pulp, although not significantly different ($p > 0.05$).

Table 4: TPA parameters of pineapple cookies

Samples	Hardness (g)	Cohesiveness	Springiness (mm)	Adhesiveness (mJ)
C	1926.11 ± 29.55[a]	0.05 ± 0.01[b]	0.34 ± 0.06[a]	0.16 ± 0.15[a]
F1	946.67 ± 48.85[c]	0.27 ± 0.11[a]	0.66 ± 0.24[a]	0.45 ± 0.34[a]
F2	972.84 ± 21.03[c]	0.19 ± 0.05[a]	0.60 ± 0.03[a]	0.30 ± 0.29[a]
F3	1459.89 ± 24.48[b]	0.06 ± 0.05[b]	0.42 ± 0.28[a]	0.18 ± 0.05[a]

C (control) = 100% Oat flour (coarse), F1 = 60% Oat flour (coarse) + 40% Pineapple pulp, F2 = 70% Oat flour (coarse) + 30% Pineapple pulp, F3 = 80% Oat flour (coarse) + 20% Pineapple pulp. The significant differences ($p < 0.05$) between means represented by different letters within columns.

4.0 Conclusion

Bakery products are broadly consumed worldwide. It was discovered that using pineapple pulp to make cookies could result in a successful and innovative formulation. The pulp of a pineapple is a valuable source of dietary fibre. The percentage of replacement for pineapple pulp was increased from 20% to 40%, resulting in increased moisture and crude fibre content. Meanwhile, the springiness, cohesiveness, and adhesiveness of cookies were enhanced to a greater level as the percentage of pineapple pulp in the cookies increased. The percentage of pineapple pulp affected the hardness level of the cookies, i.e., an increase in the percentage of pineapple pulp resulted in a decrease in hardness. The sensory characteristics liking results indicated that replacing 40% pineapple pulp with 60% oat flour in cookies is most acceptable.

References

AOAC (Association of Official Analytical Chemists) (2000). Official Methods of Analysis. 15th edition. (Gaithersborg.s.edn). AOAC press, Washington DC, USA. pp. 78-90.

Ackom, N. B., & Tano-Debrah, K. (2012). Processing pineapple pulp into dietary fibre supplement. *Journal of Food, Agriculture, Nutrition and Development, 12*(6), 6823-6834.

Aziz, M., Yasmin, I., Batool, R., Khan, W. A., Naz, S., Ashraf, F., . . . Iqbal, R. (2020). Exploring the effect of apricot addition on nutritional, antioxidant, textural and sensory characteristics of cookies apricot supplemented functional cookies. *Italian Journal of Food Science, 32*(4), 831-844.

Bakare, A. H., Adeola, A. A., Otesile, I., Obadina, A. O., Afolabi, W. A., Adegunwa, M. O., . . . Alamu, E. O. (2020). Nutritional, texture, and sensory properties of composite biscuits produced from breadfruit and wheat flours enriched with edible fish meal. *Food Science & Nutrition, 8*(11), 6226-6246.

Blüher, M. (2019). Obesity: global epidemiology and pathogenesis. *Nature Reviews Endocrinology, 15*(5), 288-298.

Campo Vera, Y., Lizcano Rojas, N. C., & Monroy Parra, M. L. (2016). Elaboración de galletas funcionales con adición de clorofila. *Alimentos Hoy, 23*(36), 49-56.

Chevallier, S., Colonna, P., Buléon, A., & Valle, G. D. (2000). Physicochemical behaviors of sugars, lipids, and gluten in short dough and biscuit. *Journal of Agricultural and Food Chemistry, 48*(4), 1322–1326.

Chooi, Y. C., Ding, C., & Magkos, F. (2019). The epidemiology of obesity. *Metabolism, 92*, 6-10.

Curutchet, A., Cozzano, S., Tárrega, A., & Arcia, P. (2019). Blueberry pomace as a source of antioxidant fibre in cookies: Consumer's expectations and critical attributes for developing a new product. *Food Science and*

Technology International Business & Economics Research Journal, 25(8), 642-648.

Dan, C., Şerban, C., Sestraş, A. F., Militaru, M., Morariu, P., & Sestraş, R. E. (2015). Consumer perception concerning apple fruit quality, depending on cultivars and hedonic scale of evaluation - A case study. *Notulae Scientia Biologicae, 7*(1), 140-149.

El Khoury, D., Cuda, C., Luhovyy, B. L., & Anderson, G. H. (2011). Beta glucan: Health benefits in obesity and metabolic syndrome. *Journal of Nutrition and Metabolism, 2012*, 1-28.

Ganorkar, P. M., & Jain, R. K. (2014). Effect of flaxseed incorporation on physical, textural, sensorial and chemical attributes of cookies. *International Food Research Journal, 21*(4), 1515-1521.

Giuberti, G., Gallo, A., Fortunati, P., & Rossi, F. (2016). Influence of high-amylose maize starch addition on in vitro starch digestibility and sensory characteristics of cookies. *Starch, 68*(5-6), 469-475.

Gutierrez, K. G., Coronel, M. G., Montes, R. M., Gómez, M. N. B., Zúñiga, E. J. L., & Gutiérrez, G. V. (2017). Preparation and sensory evaluation of biscuits enriched with whey flour. *Lacandonia, 3*, 23-28.

Hathwar, S. C., Rai, A. K., Modi, V. K., & Narayan, B. (2012). Characteristics and consumer acceptance of healthier meat and meat product formulations—A review. *Journal of Food Science and Technology, 49*(6), 653–664.

Institute for Public Health, 2019. National Health and Morbidity Survey. Non-Communicable Disease, Healthcare Demand and Health Literacy. (2019). from http://www.iku.gov.my/index.php/nhms

Jensen, H. H., Kesavan, T., & Johnson, S. R. (1992). Measuring the impact of health awareness on food demand. *Review, 14*(2), 299–312.

Jia, M., Yu, Q., Chen, J., He, Z., Chen, Y., Xie, J., . . . Xie, M. (2020). Physical quality and in vitro starch digestibility of biscuits as affected by addition of soluble dietary fiber from defatted rice bran. *Food Hydrocolloids, 99*, 1-8.

Kaur, P., Kaur, K., Basha, S. J., & Kennedy, J. F. (2022). Current trends in the preparation, characterization and applications of oat starch — A review. *International Journal of Biological Macromolecules, 212*, 172–181.

Lasekan, O., & Abbas, K. A. (2012). Distinctive exotic flavor and aroma compounds of some exotic tropical fruits and berries: A review. *Critical Reviews in Food Science and Nutrition, 52*(8), 726–735.

Li, Y., Sun, Y., Zhong, M., Xie, F., Wang, H., Li, L., . . . Zhang, S. (2020). Digestibility, textural and sensory characteristics of cookies made from residues of enzyme-assisted aqueous extraction of soybeans. *Scientific Reports, 10*(1), 1-8.

López-Fernández, M., Méndez-Montealvo, G., Velazquez, G., Perales-Torres, A., Santiago-Adame, R., & Castillo-Ruiz, O. (2021). Effect of adding pineapple (*Ananas comosus*) flour on the sensory and textural properties of wheat flour (*Triticum aestivum*) cookies. *Food Engineering, 20*(3), 1-11.

Macías-Cortés, E., Gallegos-Infante, J. A., Rocha-Guzmán, N. E., Moreno-Jiménez, M. R., Medina-Torres, L., & González-Laredo, R. F. (2020). Microencapsulation of phenolic compounds: Technologies and novel polymers. *Revista Mexicana de Ingeniería Química, 19*(2), 491-521.

Mao, H., Xu, M., Ji, J., Zhou, M., Li, H., Wen, Y., . . . Sun, B. (2022). The utilization of oat for the production of wholegrain foods: Processing technology and products. *Food Frontiers, 3*, 28–45.

Mohd Ali, M., Hashim, N., Abd Aziz, S., & Lasekan, O. (2020). Pineapple (*Ananas comosus*): A comprehensive review of nutritional values, volatile compounds, health benefits, and potential food products. *Food Research International, 137*, 1-13.

Morais, D. R., Rotta, E. M., Sargi, S. C., Schmidt, E. M., Guntendorfer Bonafe, E., Eberlin, M. N., . . . Visentainer, J. V. (2015). Antioxidant activity, phenolics and UPLCESI(-)- MS of extracts from different tropical fruits parts and processed peels. *Food Research International, 77*(3), 392-399.

Mousa, M. S., El-Saadani, R. M., El- Mansy, H. A., Abd El-Salam, A. M. A., & Morsy, M. K. (2022). Physicochemical and sensory properties of functional biscuits fortified with oat flour. *Annals of Agricultural Science, Moshtohor, 60*(1), 63 – 72.

Ninfali, P., Mari, M., Meli, M. A., Roselli, C., & Antonini, E. (2019). In vitro bioaccessibility of avenanthramides in cookies made with malted oat flours. *International Journal of Food Science and Technology, 54*(5), 1558-1565.

Rosnah, S., Coskan, I., Wan Ramli, W. D., Mohd Sobri, T., & Osman, H. (2011). Effect of temperature on the rheological behaviour of 'josapine' pineapple (*Ananas comosu*s L.) pulp. *Acta Horticulturae, 902*, 449–452.

Salleh, H. S., Noor, A. M., Mat, N. H. N., Yusof, Y., & Mohamed, W. N. (2015). Consumer-behavioural intention towards the consumption of functional food in Malaysia: Their profiles and behaviours. *International Business & Economics Research Journal, 14*(4), 727–734.

Saly, A. A. S., Mohamed, S. A., Mona, M. M. D., & Amira, S. S. (2018). Preparation and evaluation of biscuits supplemented with some natural additives for children and adolescents feeding. *Journal of Food Sciences, 5*(1), 69-90.

Singh, S., Riar, C. S., & Saxena, D. C. (2008). Effect of incorporating sweet potato flour to wheat flour on the quality characteristics of cookies. *African Journal of Food Science, 2*, 65-72.

Sterna, V., Zute, S., & Brunava, L. (2016). Oat grain composition and its nutrition benefice. *Agriculture and Agricultural Science Procedia, 8*, 252–256.

Stone, H., Bleibaum, R., & Thomas, H. A. (2012). *Sensory evaluation practices, 4 th edition.* New York: Academic press.

Trinh, K. T., & Glasgow, S. (2012). On the Texture profile analysis test. from https://pdfs.seman ticsc holar.org/da6a/1a997 b8e99059db ac3f6 d61c4 b2f42 87c682.pdf

Wang, L., Li, S., & Gao, Q. (2014). Effect of resistant starch as dietary fiber substitute on cookies quality evaluation. *Food Science and Technology Research, 20*(2), 263-272.

World Health Organization (2019). Global Health Observatory (GHO) Data Obesity among Adults. Retrieved 28 November, 2019, from https://www.who.int/gho/ncd/risk_factors/overweight_obesity/obesity_adults/en/

Zhang, W., Cao, X., & Liu, S. Q. (2019). Aroma modulation of vegetable oils—A review. *Critical Reviews in Food Science and Nutrition, 60*(9), 1538-1551.