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DEVELOPMENT of OAT-BASED SNACK PASTES with HONEY and COCONUT (*COCOS NUCIFERA* L.) OIL

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ABSTRACT

Coconut oil has become popular as functional food as the consumer awareness is increasing. Snacks are preferred due to many health benefits. The aim of this study was to compare the effect of the use of honey and coconut oil on the antioxidant, physicochemical and sensory properties of snack pastes. Snack paste containing honey-coconut oil (1:0) was coded Type A, containing honey-coconut oil (1:1) was coded Type B and containing honey-coconut oil (0:1) was coded Type C. This study was observed that there were no significant differences with respect to total phenolic content among snack pastes (P >0.05). Although the difference between A and B samples was statistically insignificant with respect to pH values (P >0.05), there were significant differences among snack pastes with respect to water activity and titratable acidity (P <0.05). It was concluded that snack paste containing coconut oil can be used as an alternative to snack paste containing honey.

Keywords: Coconut oil, *Cocos nucifera* L., honey, snack paste

BAL ve HİNDİSTAN CEVİZİ (*COCOS NUCIFERA* L.) YAĞI ile YULAF BAZLI ATIŞTIRMALIK MACUNLARIN GELİŞTİRİLMESİ

ÖZ

Hindistan cevizi yağı, tüketici bilinci arttıkça fonksiyonel gıda olarak popüler hale gelmiştir. Atıştırmalıklar, çeşitli sağlık yararları nedeniyle tercih edilmektedir. Bu çalışmanın amacı, bal ve hindistan cevizi yağı kullanımının atıştırmalık macunların antioksidan, fizikokimyasal ve duyusal özellikleri üzerindeki etkisini karşılaştırmaktır. Bal-hindistan cevizi yağı (1:0) içeren atıştırmalık macun Tip A, bal-hindistan cevizi yağı içeren (1:1) atıştırmalık macun Tip B ve bal-hindistan cevizi yağı (0:1) içeren atıştırmalık macun Tip C olarak kodlanmıştır. Bu çalışmada macun örnekleri arasında toplam fenolik madde içeriği açısından önemli bir fark olmadığı görülmüştür (P >0.05). A ve B numuneleri arasındaki fark pH değerleri açısından istatistiksel olarak önemsiz olmasına rağmen (P >0.05), su aktivitesi ve titre edilebilir asitlik açısından macun örnekleri arasında farklılık önemli bulunmuştur (P <0.05). Hindistan cevizi yağı içeren atıştırmalık macunun bal içeren atıştırmalık macuna alternatif olarak kullanılabileceği sonucuna varılmıştır.

Anahtar kelimeler: Hindistan cevizi yağı, *Cocos nucifera* L., bal, atıştırmalık macun

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INTRODUCTION

The importance of novel products in the food market is increasing day by day. Consumer interest in less processed and natural alternative products has been increasing (Dikyokus, 2022; Manguldar et al., 2022). In recent years, dietary habits have changed dramatically around the world. Functional foods providing a health-promoting activity as well as the traditional nutritional value can be defined as foods that increase the quality of life. As consumers' needs have grown, the interest in functional foods as well as nutritious and pleasing sensory foods is increasing (Karelakis et al., 2019; Dikyokus, 2022; Ghosh et al., 2022; Manguldar et al., 2022).

Coconut that is one of the most important and unique foods in some tropical and subtropical countries also known as *Cocos nucifera*, a tree known for its many nutritional properties. The coconut that is quite nutritious; abundant in fibre, vitamins, and minerals is known as a functional food since it provides health advantages beyond its nutritional content (Carandang, 2008; Obidoa et al., 2010; Shankar et al., 2013; Lima, et al., 2019). Coconut oil composed of almost 90-95% saturated fatty acid is largely used for food and industrial purposes. Virgin coconut oil, the newest high-value product, is obtained directly from meat of fresh coconut. The latter is manufactured from dried coconut meat and undergoes refining process to make the oil edible (Carandang, 2008; Marina et al., 2009; Shankar et al., 2013; Dayrit, 2015; Kappally et al., 2015). Snacks that give a feeling of satiety are an important part of the diet. The development of functional snacks has received much attention in recent years due to various health advantages. Snack pastes are versatile products often can be produced with oat. Oat (*Avena sativa L.*) is a multifunctional grain that has been used as human diet with their protein quality, high unsaturated fat and fiber content and antioxidant property since ancient times. Considering the health and nutritional benefits of oat, its utilization in food production such as bread, oat milk, breakfast cereals and biscuits in the food industry has increased (Dikyokus, 2022; Manguldar, et al., 2022).

Honey that is one of the most popular functional foods is a natural bee product. Honey which is a supersaturated sugary, naturally sweet, flavorful and viscous substance is produced by honeybees (*Apis mellifera*) from flower nectar (Dikyokus, 2022; Hossain et al., 2022; Nikhat and Fazil, 2022). Hazelnut (*Corylus avellana L.*) belongs to the *Betulaceae* family. Hazelnut is a well-known tree nut around the world. The use of banana as an ingredient in different food products develops some essential minerals, resistant starch, total dietary fiber and starch. This fruit is a rich source of important phytonutrients, containing vitamins and phenolic compounds and minerals such as calcium, phosphorus, potassium, manganese, iron, zinc and magnesium etc. (Dikyokus, 2022; Manguldar et al., 2022).

In this study, coconut oil and honey were used in snack paste production. The comparison between honey and coconut oil on physicochemical and sensory characteristics and antioxidant activities of snack paste were investigated.

MATERIALS AND METHODS

MATERIALS

In this study, all the ingredients used in snack paste formulations (hazelnut, banana, honey, coconut oil, sesame, muesli containing oat and dried fruits) and molds for snack pastes were obtained from the local market. All chemicals were obtained from Merck.

METHODS

Snack paste production

Samples of snack pastes were carried out using muesli, banana, sesame, hazelnut, honey and coconut oils. It was tried to reach the most efficient final product formulation by making changes in the ratios of honey and coconut oils components in the product according to Table 1. Hazelnut and muesli were used by grinding. Each sample was weighed separately then all ingredients were mixed for about 5 min. Mixing was done manually with a sterile glass rod. Type A, B and C were prepared respectively. Type A was used as control sample. The snack pastes were placed into the cake capsule and finally, they

were wrapped in aluminum foil to be prepared for analysis and stored in the refrigerator at +4 °C.

Table 1. Snack Paste Formulations

Ingredients	Types of Snack Paste (100 g)		
	Type A*	Type B	Type C
Muesli (g)	40 g	40 g	40 g
Banana (g)	20 g	20 g	20 g
Hazelnut (g)	15 g	15 g	15 g
Sesame (g)	5 g	5 g	5 g
Coconut oil (g)	-	10 g	20 g
Honey (g)	20 g	10 g	-

***Type A was used as control sample

Physicochemical analysis

Water activity was measured by a_w meter (Novasina Labmaster Water Activity Meter, Switzerland). Sample solution was prepared for physicochemical analysis (pH and titration acidity) using the method described by Cemeroglu (2007). The pH analysis was made by pH-meter (Weilheim, Germany). Titratable acidity was done by an end point titration at pH 8.1 with 0.1 N NaOH. The results determined as citric acid, g/100mL (Sànchez-Moreno et al., 2003).

Color measurement

Color values was read by the HunterLab Spectrophotometer (HunterLab miniscan EZ, USA). Snack paste samples were transferred into 20 mm Optical Glass Cell Light Path and then analyzed. The results were given with respect to the CIELAB color system. These formulas were utilized for the calculations of Hue* and C*:

$$Hue^* = arctan\left(\frac{b^*}{a^*}\right) \quad (1)$$

$$C^* = \sqrt{(a^*)^2 + (b^*)^2} \quad (2)$$

Chemical extraction for spectrophotometric analysis

The addition of formic acid to the methanol-water mixture (75% methanol-0.1% formic acid) is suitable for the extraction of snack pastes. Snack paste samples ground with a blender (Waring Laboratory Science, Torrington, USA) were homogenized and weighed into conical falcon tubes 2.00 ± 0.01 g on a precision balance (Shimadzu, ATX224, Japan), 20 mL solvent (75% methanol-0.1% formic acid) was added and it was waited in an ultrasonic bath (Bandelin Sonorex, RK103H, Germany) for 15 minutes. It was kept waiting for the leaching activity to take place. Then, centrifugation was performed at 4°C, 3500 rpm for 10 minutes and the supernatant was collected with a Pasteur pipette. This process was performed 3 times and the liquid collected from the 3 extractions was filtered into a clean falcon tube with filter paper (0.45µm) and completely purified from its sediments. The extracted liquids were stored at +4 °C until analysis (Dikyokus, 2022).

Total phenolic content

0.5 mL of the methanolic extract, 2.5 mL of 10% Folin-Ciocalteu's reagent and 2.5 mL 7.5% $NaHCO_3$ were mixed, respectively. These mixtures were kept in a water bath at 45°C for 45 min. The mixture absorbance was then read at 765 nm using a UV-VIS (Ultraviolet visible) spectrophotometer (Biochrom, Libra S60, England). It was indicated as mg gallic acid equivalents per g (Stankovic, 2011).

Total flavonoid content

1 ml of sample extract was diluted (1:6) and mixed with 0.3 ml %5 $NaNO_2$. Then the mixture was mixed by using vortex and was kept for 5 min. Then, 0.6 mL of 10% $AlCl_3.6H_2O$ solution was put in and kept again for 5 min, the reaction mixture by adding 2 mL of 1 M NaOH solution was completed to 10mL with double-distilled

water. Afterward 15 min incubation, the absorbance was read by UV-VIS spectrophotometer at 510 nm (Biochrom, Libra S60, England). It was determined as mg rutin equivalents per gram (mg RE/g) (Sharm and Vig, 2013).

DPPH Radical Scavenging Activity

3.9 mL of the DPPH (2,2-diphenyl 1-picrylhydrazyl) solution was transferred into 100 µL of the samples and these mixture was stirred by the vortex. The mixtures were kept in dark at room temperature for 2 hour. The remaining DPPH amount was detected by reading at 515 nm. The inhibition of DPPH was evaluated as percent according to the formula

$$I\% = [(A_{blank} - A_{sample})/A_{blank}] \times 100 \quad (3)$$

A_{blank} is the absorbance of the control and A_{sample} is the absorbance of the sample extract (Huang et al., 2005; Yılmaz, 2011).

Ferric reducing capacity assay

The reducing Fe^{3+} to Fe^{2+} capability of antioxidant compounds in snack paste extracts was determined following the methods described in Oyaizu (1986). Snack paste extract (1 mL) was combined with 2.5 mL of 0.2 M sodium phosphate buffer (pH 6.6) and 2.5 mL of 1% $K_3Fe(CN)_6$. This reaction solution was kept at 50ºC for 20 min. Then, 10% trichloroacetic acid (TCA) was put in and the mixture was centrifuged at 2500 rpm for 10 min. Afterwards, 2.5 mL of distilled water and 2.5 mL of supernatant were added to 0.5 ml $FeCl_3$ (0.1%). The absorbance of the reaction mixture was read at 700 nm (Biochrom, Libra S60, England). BHT, BHA, α-tocopherol and ascorbic acid were used in the FRAP analysis.

Phosphomolybdenum assay

The total antioxidant capacity was measured following the methods reported in Zengin et al. (2014). Three milliliters of reactive solution including 0.6 M sulfuric acid, 28 mM sodium phosphate, and 4 mM ammonium molybdate was transferred into 300 µl snack paste extract quickly. Then it was kept at 95°C for 90 min, the absorbance was read at 695 nm (Biochrom, Libra S60, England). It was detected as equivalents of trolox (µg/TE g).

Ascorbic acid content

The ascorbic acid content was read at 518 nm by using Hısıl (2004) method with some alterations. As standard L-ascorbic acid was used.

Sensory analysis

Sensory evaluation of snack paste samples was been carried out by 10 panelists according to previously described study with some modifications by (Manguldar et al., 2022). Same amount of each sample were weighed into molds and 3-letter random codes were given. Snack paste samples were determined for appearance, chewiness, taste and aroma, odor and general acceptability using the hedonic scale from 1 (dislike extremely) to 5 (like extremely).

Statistical analysis

The SPSS 23.0 for Windows (SPSS Inc. Chicago, IL, USA) was applied for analysis of variance and Duncan's multiple comparison tests. Different snack paste samples were used as variables, confidence level was 95%, all analyses was done with three replicates.

RESULTS AND DISCUSSION

Physicochemical analyses

The results of the physicochemical analysis of snack paste samples are shown in Table 2. It can be seen that the pH values of snack pastes were 6.38, 6.42 and 6.53, respectively. Titratable acidity (TA) values of snack pastes ranged from 0.17 to 0.24 g/100 g. Water activities (a_w) of snack paste samples were determined as 0.837, 0.943 and 0.862, respectively. Although the difference between A and B samples was statistically insignificant with respect to pH values ($P > 0.05$), there were significant differences among snack pastes with respect to water activity and titratable acidity ($P < 0.05$) (Table 2). Similar a_w results have been observed elsewhere. Ibrahim et al. (2021) reported that the highest a_w (0.869 and 0.889) was found in the control sample. The lowest aw (0.654 and 0.721) contained in a snack bar had the lowest amount of date paste. Munir et al. (2018) observed that TA values of date based snack bars

varied between 0.3-0.4% and also a_w of date based snack bars varied between 0.559 and 0.613. Abdel-Salam et al. (2022) reported that pH values in snack bars were changed between 5.22 and 5.83 and acidity values of snack bars were altered between 0.37-0.47%. The differences in the results found in the present study and those mentioned in the literature may be due to the various formulations.

Table 2. Physicochemical analysis results of different snack paste samples

Samples	Analysis		
	pH	Titratable Acidity (g/100 g)	Water Activity (a_w)
A*	6.38±0.04^b	0.20±0.00^b	0.837±0.00^c
B	6.42±0.02^b	0.24±0.00^a	0.943±0.00^a
C	6.53±0.03^a	0.17±0.00^c	0.862±0.00^b

Values followed by different superscripted letter within the same column are significantly different from each other ($p<0.05$)
*****Type A was used as control sample

Color Measurement (L*, a*, b*, hue and chroma)

The color of snack paste is one of the most significant parameters for detecting consumer acceptance. The color results (lightness, redness, and yellowness) of the snack paste samples are given in Table 3. L*values were evaluated as 37.19, 43.42 and 47.44, respectively. The a* and b* values were evaluated as 8.08, 30.09 and 6.25, 16.53 and also 5.28 ,11.73, respectively. It can be seen that hue and chroma values were 74.96, 31.16 and 68.48, 17.69 and also 64.87, 12.91, respectively. It was observed that there were significant differences among L* and H* color values of snack pastes ($P<0.05$). Compared to the control sample, while the lightness increased in both samples B and C; It was determined that the redness and yellowness values, which are a and b values, decreased. The highest lightness was detected in the C sample. This is thought to be due to the added coconut oil. The lightness increased as the amount of coconut oil added increased. Bchir et al. (2018) stated that cereal bars obtained from pear and wheat bran had higher L*, while, a* and b* values were positive among all cereal bar types.

Table 3. Color values of snack paste samples

Samples	Analysis				
	L*	a*	b*	Hue	Chroma
A*	37.19±0.61^c	8.08±0.20^a	30.09±1.73^a	74.96±0.53^a	31.16±1.72^a
B	43.42±1.08^b	6.25±0.92^b	16.53±5.44^b	68.48±3.99^{ab}	17.69±5.40^b
C	47.44±1.94^a	5.28±0.16^b	11.73±3.22^b	64.87±6.19^b	12.91±2.93^b

Values followed by different superscripted letter within the same column are significantly different from each other ($p<0.05$)
*****Type A was used as control sample

Phytochemical Contents and Antioxidant Activity of Snack Paste Samples

It is accepted that snack products have rich phenolic content and make the substantially contribution to their antioxidant activity. Therefore, determination of phenolic and antioxidant content in a snack product is important for such studies. The results of antioxidant activity of snack paste samples are shown in Table 4. It can be seen that the total phenolic contents of snack paste samples were 0.047, 0.045 and 0.047 mg GAE/g, respectively. It can be seen that the total flavonoid contents of snack paste samples were 0.026, 0.025 and 0.020 mg RE/g, respectively. This is because flavonoids are the subgroup of phenolics. Singh et al. (2022) stated that plant-based food products are a source of polyphenols and flavonoids with antioxidant

and nutritional properties. It can be seen that the ascorbic acid contents of snack paste samples were 78.46, 72.12 and 64.81 mg/L, respectively. Vitamin C is an excellent antioxidant that actively fights free radicals to delay the onset of aging. The addition of vitamin C to bars may be responsible for the rise in antioxidant activity (Silva et al., 2016). It can be seen that the DPPH inhibition of snack paste samples were 33.10%, 28.36% and 32.67%, respectively. As shown in Table 4, it can be seen that reducing power of snack paste samples were 1.195, 0.739 and 1.332, respectively. The electron donating ability of the substance, which is an important mechanism for antioxidant activity, is demonstrated by the reduction of Fe^{3+} ions (FRAP). The idea that a high absorbance value indicates a high reducing capacity is widely accepted. The results were compared with standards for BHA, BHT, α-tocopherol, and ascorbic acid (Table 5). In order to determine their capacity to reduce Fe^{3+}, snack pastes were examined at normal quantities. Since the standards were used at the microgram level, reducing power values of snack samples were rather higher than standards. It can be seen that the total antioxidant capacity (phosphomolybdenum assay) of snack paste samples was 0.10, 0.03 and 0.14 μg/TE g, respectively. While the difference between total phenolic content among snack paste samples was statistically insignificant (P >0.05); For other antioxidant analyses, the difference between the samples was statistically significant (P <0.05) (Table 4). Abdel-salam et al. (2022) reported that the nutrition bars in their study indicated higher antioxidant activity since the antioxidant activity of ingredients used in preparation of these bars. Singh et al. (2022) said that inhibiting oxidative chain reactions and free radicals in tissues and membranes, which protects the organism from tissue damage, is one important function of antioxidants. Our findings suggested that antioxidant components of snack pastes might be effective in reducing the negative effects of free radicals.

Table 4. Phytochemical contents and antioxidant activity analysis results of different snack paste samples

Samples	Analysis					
	Total phenolics (mg GAE/g)	Total flavonoids (mg RE/g)	Ascorbic acid (mg/L)	DPPH Inhibition (%)	FRAP (abs.)	Phosphomolybdenum assay (total antioxidant capacity; (μg/TE g))
A*	0.047±0.00^{a}	0.026±0.00^{a}	78.46±0.58^{a}	33.10±0.50^{a}	1.195±0.07^{b}	0.10±0.02^{b}
B	0.045±0.00^{a}	0.025±0.00^{a}	72.12±10.16^{ab}	28.36±1.21^{b}	0.739±0.01^{c}	0.03±0.00^{c}
C	0.047±0.00^{a}	0.020±0.00^{b}	64.81±4.16^{b}	32.67±0.28^{a}	1.332±0.04^{a}	0.14±0.00^{a}

Values followed by different superscripted letter within the same column are significantly different from each other ($p<0.05$)

*****Type A was used as control sample

Table 5. Standarts used for FRAP (Ucan Turkmen et al., 2020).

Analysis	Standards	Concentrations				
		20 μg/mL	50 μg/mL	100 μg/mL	200 μg/mL	400 μg/mL
FRAP	BHT	0.07±0.00^{e}	0.09±0.00^{d}	0.14±0.00^{c}	0.33±0.02^{b}	0.45±0.01^{a}
	BHA	0.22±0.01^{d}	0.24±0.01^{cd}	0.25±0.02^{c}	0.32±0.03^{b}	0.51±0.01^{a}
	α-tocopherol	0.13±0.00^{e}	0.15±0.00^{d}	0.16±0.01^{c}	0.20±0.01^{b}	0.29±0.01^{a}
	Ascorbic acid	0.12±0.00^{e}	0.13±0.00^{d}	0.17±0.00^{c}	0.25±0.00^{b}	0.37±0.00^{a}

(The data shown are the mean values of n=3. The difference between the values expressed with different symbols (a-e;a-d) in the same lines in the graph was significant ($p<0.05$)).

Sensory Evaluation

The snack pastes showed sensory rating scores in the range from worst to best: appearance (2.8–3.6), chewiness (2.4–3.2), odor (3.8–4.1), taste and aroma (3.2–4.4), and overall acceptability (3.5–4.3) as shown in Table 6. As a result of the sensory analysis performed between different snack paste samples, the difference between apperance and odor analyzes was statistically insignificant (P >0.05); For taste and aroma, chewiness and overall acceptability, the difference between samples was statistically significant (P <0.05).The hewiness parameters tended to increase as the ratio of coconut oil increased. Many studies have focused the impacts of different raw materials on the sensory properties and overall acceptability of snack paste and bars. Padmashree et al. (2012) claimed that significant decrease in all the sensory features like aroma, color, taste, texture and general acceptability occurred throughout storage. Joy et al. (2016) studied that maize and coconut can be used instead of oat and walnut in the production of granola of good quality without changing the flavor, texture and crispness of the original oat-based product. González-Calderón et al. (2021) studied on impact of the different vegetal mixtures on the nutritional, functional, and sensory attributes of snacks based on pseudocereals. They said that the use of non-traditional ingredients with high antioxidant activities revealed as a good way to make sensory acceptable food products. Abdel-Salam et al. (2022) stated that sensory acceptance of nutrition bars is related to various components like oats and dried fruit and binders like honey.

Table 6. Sensory analysis results of snack paste samples

Samples	Analysis				
	Apperance	Chewiness	Odor	Taste and Aroma	Overall Acceptability
A*	3.5±1.12^{a}	2.4±0.85^{b}	3.8±1.07^{a}	4.4±0.90^{a}	4.3±0.74^{a}
B	2.8±1.12^{a}	2.8±0.85^{ab}	4.1±1.02^{a}	3.2±0.92^{b}	3.5±0.74^{b}
C	3.6±1.09^{a}	3.2±0.83^{a}	3.9±1.07^{a}	3.7±0.86^{ab}	4.1±0.72^{a}

Values followed by different superscripted letter within the same column are significantly different from each other (p<0.05)

*****Type A was used as control sample

CONCLUSION

To determine the best mixture of snack paste, three different combinations of two main components were used. The effect of the use of honey and coconut oil on the antioxidant, physicochemical and sensory properties of snack pastes was evaluated. As a results of sensory evaluation, it was revealed that coconut oil can be used as alternative to honey as an ingredient when making snack paste. Honey containing snack pastes present acceptable sensorial properties like odor and appearance, similar to coconut oil containing snack pastes with higher chewiness. Considering the data obtained from this study, it was observed that snack paste including coconut oil has higher antioxidant activity. Based on this study, it has been shown that snack paste containing coconut oil can be used as an alternative to snack paste containing honey as a novel food product. Further analyses for snack pastes supporting the antioxidant activities would provide the creation of improved less processed food products containing alternative ingredients.

CONFLICT OF INTEREST

The author has declared no conflict of interest

AUTHORS' CONTRIBUTIONS

Both authors significantly contributed to different processes in the article. The authors read and approved the final manuscript.

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REFERENCES

Abdel-salam, F. F., Ibrahim, R. M., Ali, M. I. (2022). Formulation and Evaluation of High Energy-protein Bars as a Nutritional Supplement

for Sports Athletics. *American Journal of Food Science and Technology*, 10(1), 53-65. DOI:10.12691/ajfst-10-1-8

Bchir, B., Jean-François, T., Rabetafika, H. N., Blecker, C. (2018). Effect of pear apple and date fibres incorporation on the physico-chemical, sensory, nutritional characteristics and the acceptability of cereal bars. *Food Science and Technology International*, 24(3), 198-208. DOI: 10.1177/1082013217742752

Carandang, E. V. (2008). Health benefits of virgin coconut oil. *Indian Coconut Journal-Cochin*, 38(9), 8.

Cemeroğlu B. (2007). Gıda Analizleri. Gıda Teknolojisi Derneği Yayınları No: 34, Ankara.

Dayrit, F. M. (2015). The properties of lauric acid and their significance in coconut oil. *Journal of the American Oil Chemists' Society*, 92, 1-15. DOI 10.1007/s11746-014-2562-7

Dikyokuş, H. (2022). Arı ürünleri ile zenginleştirilmiş karabuğday granola üretiminin yanıt yüzey yöntemiyle optimizasyonu. Yüksek Lisans Tezi, Bursa Uludağ Üniversitesi, Bursa, Türkiye.

Ghosh, S., Sarkar, T., Pati, S., Kari, Z. A., Edinur, H. A., Chakraborty, R. (2022). Novel bioactive compounds from marine sources as a tool for functional food development. *Frontiers in Marine Science*, 9, 76. https://doi.org/10.3389/fmars.2022.832957

González-Calderón, A. K., García-Flores, N. A., Elizondo-Rodríguez, A. S., Zavala-López, M., García-Lara, S., Ponce-García, N., Escalante-Aburto, A. (2021). Effect of the addition of different vegetal mixtures on the nutritional, functional, and sensorial properties of snacks based on pseudocereals. *Foods*, 10(10), 2271.

Hısıl, Y. (2004). Enstrümental Gıda Analizleri-Laboratuvar Deneyleri. Ege Universitesi, Mühendislik Fakültesi, Ders Kitapları, Bornova, Izmir, Yayın No. 45, 39 pp.

Hossain, M. L., Lim, L. Y., Hammer, K., Hettiarachchi, D., Locher, C. (2022). A Review of Commonly Used Methodologies for Assessing the Antibacterial Activity of Honey and Honey Products. *Antibiotics*, 11(7), 975. https://doi.org/10.3390/antibiotics11070975

Huang, D., Ou, B., Prior, R.L. (2005). The chemistry behind antioxidant capacity assays. *Journal Agriculture and Food Research*; 53(6):1841-56. DOI: 10.1021/jf030723c

Ibrahim,S.A., Fidan, H. Aljaloud, S.O. Stankov, S. Ivanov, G. (2021) Application of Date (*Phoenix dactylifera* L.) Fruit in the Composition of a Novel Snack Bar. *Foods, 10*, 918. https://doi.org/10.3390/foods10050918

Joy, E. E., Aswei, B. E., Nicholas, G. M. (2016). Preparation and Evaluation of Granola–a Breakfast Cereal, Sustituted with Maize (Zea May) and Coconut (Cocos Nucifera) Blend. *International Journal of Nutrition and Food Science*, 5(1), 47.

Kappally, S., Shirwaikar, A., Shirwaikar, A. (2015). Coconut oil–a review of potential applications. *Hygeia journal for drugs and medicines*, 7(2), 34-41. DOI: 10.15254/H.J.D.Med.7.2015.149

Karelakis, C., Zevgitis, P., Galanopoulos, K., Mattas, K. (2019). Consumer trends and attitudes to functional foods. *Journal of International Food & Agribusiness Marketing*, 32(3), 266-294 https://doi.org/10.1080/08974438.2019.1599760

Lima, R. D. S., Block, J. M. (2019). Coconut oil: what do we really know about it so far? *Food Quality and Safety*. https://doi.org/10.1093/fqsafe/fyz004

Manguldar, F., Derya, B., Balbinar, S., Çakır, Ş., Icyer, N. C., Cayir, M., ... Şentürk, B. (2022). Vegan and gluten-free granola bar production with pumpkin. *European Food Science and Engineering*, 3(2), 52-57. https://doi.org/10.55147/efse.1166320

Marina, A. M., Man, Y. C., Amin, I. (2009). Virgin coconut oil: emerging functional food oil. *Trends in Food Science & Technology*, 20(10), 481-487 https://doi.org/10.1016/j.tifs.2009.06.003

Munir, M., Nadeem, M., Qureshi, T. M., Qayyum, A., Suhaib, M., Zeb, F., Ashokkumar, M. (2018). Addition of oat enhanced the physico-chemical, nutritional and sensory qualities of date fruit

based snack bars. *Journal of Food and Nutrition Research*, *6*(4), 271-276. doi: 10.12691/jfnr-6-4-10.

Nikhat, S., Fazil, M. (2022). History, phytochemistry, experimental pharmacology and clinical uses of honey: A comprehensive review with special reference to Unani medicine. J*ournal of Ethnopharmacology*, 282, 114614. https://doi.org/10.1016/j.jep.2021.114614

Obidoa, O., Joshua, P. E., Eze, N. J. (2010). Phytochemical analysis of Cocos nucifera L. *Journal of Pharmacy Research*, 3(2), 280-286.

Oyaizu, M. (1986). Studies on Product of Browing Reaction Prepared from Glucose amine. *Japan of Nutrition*, 44, 307-315 https://doi.org/10.5264/eiyogakuzashi.44.307

Padmashree, A., Sharma, G.K., Srihari, K.A., Bawa, A.S. (2012). Development of shelf stable protein rich composite cereal bar. *Journal of Food Science Technology*. 49, 335–341.

Sánchez-Moreno, C., Plaza, L., de Ancos, B., Cano, M. P. (2003). Quantitative bioactive compounds assessment and their relative contribution to the antioxidant capacity of commercial orange juices. *Journal of the Science of Food and Agriculture*, 83(5), 430-439. https://doi.org/10.1002/jsfa.1392

Shankar, P., Ahuja, S., Tracchio, A. (2013). Coconut oil: a review. *Agro Food Industry Hi-Tech*, 24(5), 62-64.

Sharm S, Vig P.A. (2013). Evaluation of In vitro Antioxidant Properties of Methanol and Aqueous Extracts of Parkinsoniaaculeata L. Leaves. *The Scientific World Journal*, 1-7. https://doi.org/10.1155/2013/604865

Silva, E. P. D., Siqueira, H. H., Damiani, C., Vilas Boas, E. V. D. B. (2016). Physicochemical and sensory characteristics of snack bars added of jerivá flour (Syagrus romanzoffiana). *Food Science and Technology*, 36, 421-425.

Singh, A., Kumari, A., Chauhan, A. K. (2022). Formulation and evaluation of novel functional snack bar with amaranth, rolled oat, and unripened banana peel powder. Journal of *Food Science and Technology*, 59(9), 3511-3521.

Stanković M.S. (2011). Total Phenolic Content, Flavonoid Concentration and antioxidant Activity of *Marrubium Peregrinum* L. Extracts. *Kragujevac Journal of Science*. 33(2011):63-72.

Uçan Türkmen, F., Mercimek Takcı, H. A., Sarıgüllü Önalan, F. E. (2020). Evaluation of Antioxidant Activity of Sour Cherry Stalk Extracts by in Vitro Methods. *Karadeniz Fen Bilimleri Dergisi*, 10(2), 290-301.

Yılmaz O.M. (2011). Determination of The Antioxidant Activity and Phenolic Acid Composition of Main Wheat Varieties Grown in Turkey and Enrichment of Bread with Pomegranate Husk Extract. Ph.D. Dissertation. Ankara University, Turkey, 80p.

Zengin, G., Sarikurkcu, C., Aktumsek, A., Ceylan, R. (2014). Sideritis galatica Bornm.: A source of multifunctional agents for the management of oxidative damage, Alzheimer's's and diabetes mellitus. *Journal of Functional Foods*, 11, 538–547. https://doi. org/10.1016/j.jff.2014.08.011