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Abstract

Our current study was designed to study the effect of fortifying snacks with date seed powders and olive seed powders as sources of dietary fiber and antioxidants. Snacks were produced from wheat flour by substituting 15 % of wheat flour with both date seed powder and olive seed powder. The nutritional and phytochemical of plant sources were evaluated. Also, the nutritional, microbiological, phytochemical and sensory characteristics of snacks were investigated. From the results of the study, it became clear that the contents of moisture, fibers, carbohydrates, total phenols and antioxidant activity in olive seed powder were higher than date seed powder, while fat, protein and ash contents in olive seeds powders were lower than date seed powder. Substituting 15% of wheat flour with both date seed powder and olive seed powder increased the moisture, fat, fibers, carbohydrates, total phenols and antioxidant activity contents of the produced snacks. The yeast, mold and coliform counts are not discovered in all the stored samples of the snacks. Adding of date seed powder and olive seed powder caused a significant decrease in the standard plate counts during the 45 days of storage compared to control snacks. All manufactured snacks are acceptable. The general appearance and acceptance did not differ much for all snacks. The study established that application of date seed powder and olive seed powder enhanced the nutritional, microbiological, phytochemical and sensory properties of snacks.

Key words; Bakery products, Wheat flour, Plant seeds, nutritional, Polyphenols, Phytochemical, kernel and olive seeds.

الوجبات الخفيفة المدعمة بمسحوق نوي التمر وبذور الزيتون: تقييم الخصائص الغذائية، الكيميائية، الميكروبيولوجية والحسية

تهدف الدراسة إلى تقييم الوجبات الخفيفة المدعمة بمساحيق بذور التمر وبذور الزيتون كمصادر لمضادات الأكسدة والألياف الغذائية . حيث تم إنتاج وجبات خفيفة من دقيق القمح عن طريق استبدال ١٥ ٪ من دقيق القمح بكل من مسحوق بذور التمر ومسحوق بذور الزيتون.

وتم تقييم الخصائص الغذائية والمضادة للاكسدة للمصادر النباتية . أيضا، تم تقييم الخصائص الكيميائية والميكروبيولوجية والمضادة للاكسدة والحسية للوجبات الخفيفة. أظهرت النتائج أن محتوى الرطوبة والألياف والكربوهيدرات والفينولات الكلية ونشاط مضادات الأكسدة في مسحوق بذور الزيتون كان أعلى من مسحوق بذور التمر، بينما كانت محتويات الدهون والبروتين والرماد في مساحيق بذور الزيتون أقل من مسحوق بذور التمر. وان استبدال ١٥ ٪ من دقيق القمح بكل من مسحوق بذور التمر ومسحوق بذور الزيتون زاد من الرطوبة، الدهون، الألياف، الكربوهيدرات، الفينولات الكلية ومحتويات نشاط مضادات الأكسدة من الوجبات الخفيفة . ولم يتم العثور على الخميرة أوالفطريات أوبكتيريا القولون لجميع العينات المخزنة من الوجبات الخفيفة . كما ان إضافة مسحوق بذور التمر ومسحوق بذور الزيتون أدي الي انخفاض كبير في عدد البكتيريا الكلية خلال ٤٥ يومًا من التخزين مقارنة بوجبات المقارنة الخفيفة . وكانت جميع الوجبات الخفيفة بالتجربة مقبولة ولم يختلف المظهر العام والقبول كثيرًا لجميع الوجبات الخفيفة . وخلصت الدراسة إلى أن استخدام مسحوق بذور التمر ومسحوق بذور الزيتون قد أدى إلى تحسين الخصائص الغذائية والكيميائية والميكروبيولوجية والمضادة للاكسدة والحسية للوجبات الخفيفة.

1. Introduction

The attractiveness of bakery products has led to a recent increase in request for ready-to-eat food products, including bread, biscuits, and other pastries (**Nadeeshani *et al*, 2022; El-Araby, 2022**). In this setting, new food products containing food additives have been established, particularly in the manufacture of snacks, which are expedient ready-to-eat foods that are expended by adults in numerous countries (**Forsido et al, 2019**). Around the world, there is a general trend towards the repurposing of by-products, such as certain agronomic crop remains, as functional food constituents in food design (**Abd Rabo *et al*, 2019**). This trend is especially noticeable when it comes to utilizing fruit waste, such as pomace, seeds, or vegetable peels, because of their great concentration of dietary fibres and bioactive composites (**Chaouch and Benvenuti, 2020**).

In fact, producing agricultural commodities like fruit and vegetable goods generates a lot of trash that is hard to get rid of and pollutes the environment (**Elgindy, 2020**). Consequently, after enhancing their nutritional and industrial worth, these wastes must be worked very hard to reap the benefits (**Khedr *et al*, 2016; Arias *et al*, 2022**). The natural antioxidants found in these wastes are valuable and reasonably priced sources that can take the place of manufactured antioxidants (**Lourenço et al, 2019; Sharma *et al*, 2021).**

More than 600 types of date palm trees are being farmed, with the majority being grown in regions of North Africa and Southwest Asia (**Flowers *et al*, 2019** ; **Hussain *et al*, 2020**). The edible portion of date fruit has low levels of fat, protein, ash, and polyphenols and high levels of sugars and dietary fibres (**Siddiqi *et al*, 2020; Echegaray *et al*, 2023**). The date seed, which is inedible and makes up over 6% of the fruit, is a main waste product in the date treating industry (**Oladzad *et al*, 2021**). It is high in antioxidants and contains sizable amounts of proteins, lipids, minerals, fibre, and vitamins (**Attia et al, 2021; Haris *et al*, 2023**). It has been demonstrated that date seed may lessen liver damage and shield rats from hepatotoxicity (**Najjar et al, 2022a; Echegaray *et al*, 2023**).

Olives, also known as *Olea europaea* L., are a vitamin-rich food that are grown around the world and belong to the Oleaceae family. Phytochemicals are abundant in it (**Hannachi *et al*., 2020**). One could view olive stones, or seeds, as significant byproducts. Their main structural component is made of strong lignified fibres. They consist mostly of hemicelluloses, cellulose, and lignin, although they also contain trace amounts of protein and fat. The oil found in olive seeds (22–27% of their weight) is higher in total polyunsaturated fatty acids (PUFA) and individual sterols than the olive fruit (**Maestri *et al*, 2019**). Furthermore, studies have demonstrated the abundance of phenolic chemicals found in olive stones, primarily flavones, as well as glycoside molecules such salidroside, glucose nuzhenide, and nuzhenide-oleoside. One of the main phenolic compounds in the fruit flesh is verbascoside (**Jahanbakhshi & Ansari, 2020**).

According to **Potter et al. (2013)** and **Basto *et al*. (2016)**, studies have looked at how different food sources can improve snacks. Therefore, the present study aimed to use both date and olive seeds powderto improve the nutritional value and enhance the antioxidants of some snacks. As a great source of micronutrients, date or olive stones can be ground up and added to flour to increase dietary fibre and phenolic compounds, which act as antioxidants. In this outline, the recent employment is designed to estimate the impact of the supplementation of snacks with date and olive seed powders as bases of antioxidant and dietary fibers. The nutritional, chemical, and sensory characteristics of the produced snacks are finally considered and associated.

2. Materials and Methods

2.1. Materials and Reagents

The local market in Zagazig city, Egypt provided the wheat flour (72% extraction), olive fruits, palm date, sugar powder, maize oil, ammonium bicarbonate and sodium chloride. 1,1-diphenyl-2-picrylhydrazyl (DPPH), gallic acid, additional chemicals and reagents

were bought from Sigma-Aldrich (MO, IL, USA). The chemicals were graded as analytical reagents.

2.2. Methods

2.3. Olive Seed Powder Preparation

Following cleaning and washing, the seeds of olive were pulverized in a laboratory mill and sifted to a 100 µm unit size. They were then dried in an oven (Binder, Germany) at 50°C to a final moisture content of 6% (w.b.) (**Jahanbakhshi & Ansari, 2020**). The powder was refrigerated at 4°C in glass containers until it underwent chemical examination (three times replicates).

2.4. Date Seed Powder Preparation

In order to obtain date seed powder with particles smaller than 250 µm in diameter, date seeds were soaked in water for six hours, allowed to air dry for three days, then ground using a Teeba Date Seed Grinding Machine (Higao Tech Co.,Ltd- HS Code, 847982- China) and sieved (**Najjar *et al*, 2022b**). The powder was refrigerated at 4°C in glass containers until it underwent chemical examination.

2.5. Preparation of Snacks

The flour mixtures, based on wheat flour (WF) and date seed powder (DSP) or olive seed powder (OSP), were formulated rendering to the ratios offered in Table 1, combining 100 g of blended flour with 10 grammes of sunflower oil, 1.5 grammes of active dry yeast, 5 grammes of baking powder, 10 grammes of tomato sauce, and 7.5 grammes of sugar. The resulting dough was fermented for an hour at a temperature of 30 degrees Celsius and a relative humidity of 85%. Subsequently, 20 mg weight pieces were extracted from the entire dough, placed on trays, and allowed to ferment for 45 minutes at a temperature of 30 degrees Celsius and a relative humidity of 85%.. An extruder (US-made model 2013) was then baked for 10 minutes at 230 °C. Lastly, prior to the study, the snacks were allowed to cool on racks for one hour (**Hussein, 2022**).

Table 1. The prepared Snacks formula**e**

Sample No.	Blends (%)		
	Wheat flour (W.F)	**Date seed powder (DSP)**	**Olive seed powder (OSP)**
100% WF (C)	100.00	00.00	00.00
85%WF+15%DSP (T1)	00.00	15.00	00.00
85%WF+15%OSP (T2)	00.00	00.00	15.00

2.6. Chemical Analysis

Fat, moisture, ash, protein, and crude fibers amounts of raw material (WF, DSP, and OSP) and snack samples were assessed conferring to the **AOAC (2005).** Available carbohydrate was computed

by difference (Total carbohydrates% = 100 – (%fat + %protein + %ash + %fiber +%moisture), while the mineral ingredients of raw material and produced snacks were assessed with a Hitachi Z6100 (Tokyo, Japan) atomic absorption spectrophotometer.

2.7. Determination of Total Phenolic Content

Using the Folin-Ciocaltaeu reagent method, the total amount of phenolic compounds found in the extracts (raw materials and snack samples) was calculated concurring to **Kaur and Kapoor, (2002**). The standard utilized was gallic acid. Using a standard calibration curve achieved from the absorbance readings read beside the gallic acid solutions in ethanol at 25, 50, 100, 150, 200, 250, and 500 µg/mL concentrations, total phenols were expected as gallic acid equivalents. Using a Shimadzu 1201 instrument, spectrophotometric and absorbance measurements were created at 765 nm.

2.8. Determination of DPPH Radical Quenching Activity

Using **Thaipong *et al.* (2006**)'s approach, the 2,2-dipheny-l,1-picrylhydrazyl (DPPH) activity was ascertained. This tried-and-true technique assesses how well the stable free radical DPPH can interact with phenolic compounds that have the ability to donate hydrogen in the reaction medium. Spectrophotometric monitoring at 517 nm shows that the reaction caused the DPPH levels to drop. A positive control was butylated hydroxyanisole. The standard was made in diluted solutions with concentrations of 5, 10, 25, 50, 100, and 150 µg/mL. A 70% methanol solution containing 0.1 mM of DPPH was made. The standard/sample solution was taken and put into test tubes in an amount of 3 mL. Following the addition of 1 mL of the DPPH solution, the mixture was well vortexed and allowed to sit at room temperature in the dark for 30 minutes. The absorbance was measured in the spectrophotometer at 517 nm at the conclusion of the incubation. Based on the absorbance values in comparison to the DPPH solution expended as a control, the radical scavenging effects (%) of the solutions were computed using the next equation;

DPPH radical scavenging activity = ((*A*0–*A*1)/*A*0)×100

The solution made by mixing only 3 mL of me-thanol and 1 mL of DPPH solution without addition any chemicals was expended as a control solution.

*A*0 is the absorbance of control; *A*1 is the absorbance of sample/standard.

2.9. Fractionation and Identification of Phenolic and Flavonoid Compounds

Fractionation and identification of phenolic and flavonoid compounds was done using a high-performance liquid chromatography

system from the Agilent Technologies, Germany 1200 series, which was fitted with a variable wavelength detector. In addition, the HPLC had a column compartment that was adjusted at 35˚C, an auto-sampler, and a quaternary pump degasser. A C18 reverse-phase (BDS 5 µm, Labio, Czech Republic) packed stainless-steel column (4×250 mm. i.d.) was used for the analysis. Samples were generated using the protocol outlined by **Atawodi et al. (2011)** in order to assess the presence of flavonoids and phenolic acids.

2.10. Antimicrobial Assay

The Microbiological Resources Centre (MIRCEN), Faculty of Agriculture, Aim Shams University, provided stock cultures from which the ATCC microbial strains were derived. The primary goal of experimental study was to; assess the antimicrobial properties of date and olive seed extracts against American type culture microbial strains (ATCC), i.e., Gram-positive *Staphylococcus aureus* (ATCC 29213), Gram-negative *Escherichia coli* (ATCC 25922) bacteria, and the fungus *Candida albicans* (ATCC 66027) and to evaluate the antibacterial and antifungal activity of these date and olive seed ethanolic extracts.

In accordance with the Clinical and Laboratory Standards Institute (CLSI) procedure, the antibacterial activity of date and olive seed extracts was initially assessed using the agar "well diffusion method" (**Khan et al, 2011; Wikler, 2019)**. The microbes were cultured in nutrient agar at 37°C for an entire night. To achieve a bacterial concentration of 1-2×10^8 CFU/mL, a standard solution was generated using sterile normal saline and turbidity equivalent to 0.5 McFarland. To obtain semi-confluent growths, sterile cotton swabs were immersed in the suitable test organism suspension and consistently splashed over the agar plate's surface. Using the back side of the sterilized micropipette tips, six wells (6 mm) were created for each plate. Using a micropipette, 50 µL of the corresponding filter-sterilized pit extract was added to each well. Used as the negative control was DMSO. The plates were incubated at 37°C for 24 hours after the experiment was carried out in a laminar air flow cabinet that had been sterilised. Conventional antibiotics, such as fluconazole (25 µg) for *Candida albicans* and amikacin (30 µg) for *S. aureus* and *E. coli*, were utilised as positive controls. Every extract was examined three times. Inhibition zones were found, and their dimensions were estimated in millimeters (**Khan *et al.*, 2011; Wikler, 2019**).

2.11. Total Microbial Count

After 6 hours, total microbial counts were measured at room temperature (25 ± 2 °C). According to **Ranganna (2004),** plate count agar medium (PCA, Oxoid, Hampshire, UK) was utilised, and the plates

were incubated at 30 °C for 48 hours. Colony forming units (CFU mL-1) were used to directly compute the total microbial count.

2.12. Count of Coliform Bacteria

After 6 hours, the coloniform count was measured by violet red bile agar (Oxoid, Hampshire, UK) at room temperature (25±2°C). The result was immediately estimated in colony forming units (CFU mL^{-1}). 48 hours were spent incubating the plates at 37°C (**Ranganna, 2004**).

2.13. Count of Yeast and Mold

After 6 hours, the yeast and mold counts were measured at room temperature (25± 2°C) by Potato Dextrose Agar. The plates were incubated at 25°C for 5 days, as per **Ranganna, (2004)** instructions.

2.14. Sensory Evaluation of Snacks

Snacks manufactured by recommended blends were assessed for their sensory characteristics by 20 panelists from nutrition and food science, Home Economic department, Faculty of Specific education, Zagazig University for the appearance, color taste, flavor, texture, and overall acceptability on a 10-point hedonic scale (from like extremely = 10 to dislike extremely = 1) (**Hussein, 2022**).

2.15. Statistical Analysis

The analytical data were investigated by SPSS 16.0 software. Means and standard deviations were controlled by descriptive statistics. Comparisons between samples were regulated by analysis of one-way variance (AN OVA) and multiple range tests. Statistical significance was expressed at ($P \leq 0.05$).

3. Results and Discussion

3.1. Chemical and phytochemical composition of wheat flour, date seed and olive seed powder

The gross chemical composition of wheat flour (WF), date seed (DSP) and olive seed powder (OSP) is reported in Table 2 Fiber ash, fat, protein, moisture, and carbohydrate contents of WF were (0.30, 0.45, 1.70, 7.90, 12.80, and 77.15 g/100g), respectively. The findings of WF were in close compact with previously described by **Mahmoud et al, (2023)** who found that WF contains 12.24% moisture, 9.82% Protein, 1,34% fat,0.39 % ash, 0.31% fiber and 75.88% carbohydrate**.** Fiber ash, fat, protein, moisture, and carbohydrate contents of DSP were (18.20, 1.30, 9.60, 7.36, 3.28, and 77.94 g/100g) respectively. the findings of DSP were in close agreement with previously reported by **Ahmed et al , (2016)**, who found that DSP contains 3.12-3.33% moisture, 6.80- 7.80% protein, 9.20-9,50% fat, 1.19-1.27 % ash, and 17.90- 18.71% fiber. While, Fiber ash, fat, protein, moisture, and carbohydrate contents of OSP were (50.30, 1.24, 7.20, 5.30, 6.12, and 80.14 g/100g), respectively. The findings of WF were in close agreement with previously reported by

Jahanbakhshi and Ansari,(2020) , who found that OSP contains 6.01% moisture, 5.14% Protein, 7,16% fat, 1.19 % ash, 53.17% fiber and 80.03% carbohydrate .

The moisture and protein contents of WF (12.80% and 7.90%) were higher than those of DSP (3.28% and7.36%) and OSP (6.12% and 5.30%), respectively. OSP was characterized by its higher fiber and ash contents (1.24 % and 50.30%), while DSP had a higher fat content (9.60%).

The results given in Table 2 showed that the OSP is considered as having much greater levels of total phenolic (mg GAE/100 g), and antioxidant activity (AO) % than DSP and WF, i.e., 850.50 mg/100 g, and 80.60% for OSP compared to 620.80 mg/100 g and 77.50% for DSP and 180.70 mg/100 g and 62.90% for WF, respectively. The results of OSP are in line with those stated by **Batçıoğlu et al, (2023),** which found that OSP contains a high level of TPC and showed higher RSA %. Also, the results of DSP are in line with those described by **Najjar et al, (2022a)** who found that DSP contains a high level of TPC and showed higher RSA %.While the results of WF are in line with those reported by **Memon et al, (2020)** who found that WF showed a good level of TPC and RSA %.

Table 2. Chemical and phytochemical propitiates of Wheat flour, Date seed powder and Olive seed powder

Component	Samples		
	Wheat flour	Date seed powder	Olive seed powder
Chemical propitiates			
Moisture (%)	12.80^{a} ±0.55	3.28^{c} ±0.62	6.12^{b} ±0.48
Crude protein (%)	7.90^{a} ±0.60	7.36^{a} ±0.72	5.30^{b} ±0.84
Crude fat (%)	1.70^{c} ±0.40	9.60^{a} ±0.33	7.20^{b} ±0.50
Ash (%)	0.45^{c} ±0.04	1.30^{a} ±0.02	1.24^{b} ±0.03
Crude fiber (%)	0.30^{c} ±0.02	18.20^{b} ±1.2	50.30^{a} ±2.5
Carbohydrate	77.15^{b} ±1.60	77.94^{b} ±1.77	80.14^{a} ±1.32
Phytochemical propitiates			
TPC mg/100 g	180.70^{c} ±3.4	620.80^{b} ±4.2	850.50^{a} ±5.6
RSA %	62.90^{c} ±1.6	77.50^{b} ±2.3	80.60^{a} ±2.8

Mean Data are expressed as mean ± standard deviation (n = 3). Values with different superscript letters within a row are significantly different (p < .05)..

3.2. Identification of polyphenol compounds in date seed powder and olive seed powder

According to the results presented in Tables 3 and 4, In DSP ethanolic extracts 8 compounds from polyphenols namely, Gallic acid, Quinic acid, Chlorgenic acid, Cinnamic acid, Diosmin, Ferulic acid, Quercitin and Kaempferol were identified (Table 3). The polyphenolic

compounds in DSP ranged from 0.0107 to18.3707 mg/g. The predominant polyphenols compound in DSP was Quercitin (18.3707 mg/g). These results are alike to those recounted by **Hilary et al (2020),** who showed that the ethanolic extraction of DSP had high content of Quercitin.

In OSP ethanolic extracts 9 compounds from polyphenols namely, Apeginin, Gallic acid, Quinic acid, Chlorgenic acid, Vanillic acid, Hisperidin, P-coumaric, Ferulic acid and Quercitin were identified (Table 4). The polyphenolic compounds in OSP ranged from 0.0977 to 4.1306 mg/g. The predominant polyphenolic compound in OSP was Quercitin (4.1306 mg/g). These results are alike to those described by **Elbir et al, (2015),** who designated that the ethanol extraction of OSP had high content of Quercitin.

Table 3. Identification of polyphenol compounds content of date seed powder

Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount mg
Gallic acid	2.633	1.117	7.917	2.15	14.58	0.3670
Quinic acid	2.760	0.003	0.070	0.01	0.13	0.0107
Chlorgenic acid	3.053	2.502	12.054	4.81	22.19	1.9775
Cinnamic acid	4.807	0.557	3.432	1.07	6.32	0.3795
Diosmin	6.143	0.122	0.963	0.23	1.77	1.7158
Ferulic acid	12.350	1.333	4.570	2.56	8.41	n.a
Quercitin	15.360	8.215	10.161	15.79	18.71	18.3707
Unknown Phenolics	15.797	36.246	9.251	69.65	17.03	n.a
Kaempferol	16.863	1.945	5.898	3.74	10.86	n.a
Total		52.039	54.315	100.0	100.0	

Table 4. Identification of polyphenol compounds content of olive seed powder

Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount mg
Apeginin	2.490	0.083	1.343	0.50	2.84	n.a
Gallic acid	2.627	0.130	1.995	0.78	4.14	0.1834
Quinic acid	2.720	0.287	2.136	1.72	4.52	0.0977
Chlorgenic acid	3.077	0.296	1.979	1.78	4.19	0.4227
Vanillic acid	8.263	1.557	5.641	9.36	11.94	2.9664
Hisperidin	9.010	0.496	2.667	2.99	5.64	0.4396
P-coumaric	10.570	0.833	2.899	5.01	6.13	0.3111
Ferulic acid	12.317	4.900	14.413	29.46	30.49	n.a
Quercitin	15.137	8.048	14.234	48.40	30.11	4.1306
Total		16.630	47.268	100.0	100.0	

3.3. The activity of date seed and olive seed extracts against different microbial strains

Table 5 describes the bacterial and fungi activities of date seed and olive seed extracts against different bacteria and *C. albicans*. Date seed ethanolic extracts exposed an activity versus all experienced pathogens *S. aureus* (18 mminhibition zone) and *Escherichia coli* (12 mminhibition zone) except *C. albicans* . Also, olive seed ethanolic extracts exposed an activity versus all experienced pathogens *S. aureus* (23 mminhibition zone) and *Escherichia coli* (17 mminhibition zone) except *C. albicans*, compared to standard amikacin (30 µg) was consumed for *S. aureus* and *E. coli* and inhibition zone size (25 mm and 28 mm, respectively); fluconazole (25 µg) expended for *C. albicans* (31 mm).The data indicated that date seed and olive seed ethanolic extracts inhibited the tested bacteria but not *C. albicans*.

Several authors who investigated the antibacterial properties of date and olive seeds also noted the presence of flavonoids, alkaloids, polyphenols, tannins, and steroids. All of which contribute to the antioxidant action of the mixture. These secondary metabolites greatly inhibit the growth, multiplication, and infection of microorganisms and can function as powerful natural products and phytochemicals (**Amira et al, 2012; Malik, 2015**). These substances may function singly as physiologically active substances or in concert to have antimicrobial effects (**Amira et al., 2012**). Comparably, a different study found that date seed methanolic extract exhibited antibacterial activity versus *Serratia marcescens, Bacillus cereus, E. coli*, and *S. aureus* (**Samad *et al,* 2016**).Additionally, **Malik (2015)** found that the methanolic extract of olive seeds had antibacterial activity versus *S. aureus* and *E. coli*. **El Sohaimy *et al*. (2015)** discovered that the water extracts of date fruit exhibited potent antimicrobial potential versus Shigella spp. and Salmonella ssp., which are bacteria that cause diarrhoea. The plant extract contains natural compounds that are primarily responsible for the herbicidal **(Hussain *et al,* 2019**), antifungal (**Dayan et al, 2009)**, and antimicrobial activities (**Samad et al, 2016**) properties. These natural toxins may act alone as pharmaceutically active compounds or work in concert to exhibit the antimicrobial properties (**Samad *et al,* 2016**). The phytotoxicity of phenolic compounds is dependent on the number and location of hydroxyl groups (**Hussain *et al,* 2019**). Flavonoids also showed potential for antimicrobial activity, with their mode of action being attributed to discount in nucleic acid synthesis activity, disruption in energy metabolism, and cytoplasmic membrane functions (**Hussain et al, 2019**).

Table 5. Activity of date and olive seed extracts against different microbial strains (bacteria and fungi)

Extract	Inhibition Zone Diameter (mm)		
	Staphylococcus aureus	***Escherichia coli***	***Candida albicans***
Date Seed	18^{c} ±1.36	12^{c} ±0.0	0^{c} ±0.0
Olive Seed	23^{b} ±1.84	17^{b} ±0.0	6^{b} ±0.75
Amikacin (30 µg)	25^{a} ±1.14	28^{a} ±0.0	0^{c} ±0.0
Fluconazole (25 µg)	0^{d} ±0.0	0^{d} ±0.0	31^{a} ±1.40

Mean Data are expressed as mean ± standard deviation (n = 3). Values with different superscript letters within a row are significantly different ($p < .05$)..

3.4. Chemical and phytochemical propitiates of snack samples

In comparison to the control snacks, Table 6 displayed the gross chemical composition of snacks samples supplemented with DEP and OSP. It was discovered that the snacks samples' moisture contents varied from a low of 4.50% in the control to a maximum of 5.94 % in the 15% OSP snacks sample. The range of 10.90 % to 11.20 % was discovered for the protein content. Snacks ranged in ash percentage from 1.04 % to 1.22%. However, there was no change in the amount of fat found in the snacks samples when adding of OSP, but addition of DSP increased the fat content of the DSP snacks compared with control and OSP snacks . As the DSP and OSP were substituted, the fiber content of snacks grew gradually in all samples, especially, OSP snacks which contained high moisture and fiber content. This observation may be connected to the high fiber content of the DSP and OSP employed in the combinations at first. The adding of OSP raised the carbohydrates content of the OSP snacks compared with control and DSP snacks, but the addition of DSP decreased the carbohydrates content of the DSP snacks likened with control and OSP snacks.

The 15 % DSP snacks had higher fat and ash contents, while the 15 % OSP snacks had higher fiber content than the control snacks. Furthermore, when compared to control snacks, all of the snacks developed for this study may be classified as bakery goods with significant fiber content. These results are consistent with those of **Platat *et al.* (2015),** who discovered that adding date seed powder to pita bread enhanced their protein, fat, ash, and fiber content considerably ($P < 0.05$). Similar trends were previously seen by **Samea & Zidan. (2019),** who reported that the fat, ash, protein, and fiber content of cookies were dramatically boosted by the inclusion of date seed powder. Also, **Samea & Zidan. (2019),** showed that addition of olive seed powder increased the amount of protein, fat, ash and fiber content in cookies. **Çakir *et al*, (2023)** showed that adding of olive seed powder augmented the amount

of ash and fiber protein, content with increasing olive seed powder levels in bread.

Results bestowed in Table 5 revealed that the partial substitute of wheat flour with DSP and OSP raised the TPC and RSA of snacks samples likened with control snack. Snack treatments containing 15% OSP had the maximum TPC and RSA , followed by snack treatments containing 15% DSP while control sample had the lowest TPC and RSA, this may be due to a high phenolic content of OSP (**Batçıoğlu *et al*, 2023**) and DSP (**Najjar *et al*, 2022a**) . Such data are in line with those achieved by **Ahfaiter *et al* (2018**) and **Najjar *et* al (2022a**), who discovered that adding of DSP to biscuit increased the TPC and RSA of the product. Also, **Çakir *et al*, (2023)** located that adding of OSP to bread increased the TPC and RSA of the product.

Table 6. Chemical and phytochemical propitiates of prepared snacks

Items	Treatments		
	C	T1	T2
Chemical propitiates g/100g			
Moisture	4.50 ^{c}± 0.33	5.20 ^{b}± 0.50	5.94 ^{a}± 0.45
Crude protein	11.20 ^{a}± 0.15	11.0^{6} b± 0.18	10.90 ^{c}± 0.22
Crude fat	6.70 ^{b}± 0.35	7.92^{a}± 0.24	6.80 ^{b}± 0.40
Ash	1.04 ^{c}± 0.05	1.22 ^{a}± 0.03	1.16 ^{b}± 0.04
Crude fiber	1.30 ^{c}± 0.14	3.05 ^{b}± 0.18	8.65 ^{a}± 0.12
Carbohydrate	75.12 ^{b}± 0.65	74.4 ^{c}± 0.72	75.94 ^{a}± 0.46
Phytochemical propitiates			
Total phenolic content(mg/100g)	6.88 ^{c} ± 1.22	120.40 ^{b} ± 3.14	260.70 ^{a} ± 2.60
Radical scavenging activity (%)	33.90 ^{c} ± 2.04	57.60 ^{b} ± 3.70	60.30 ^{a} ± 2.80

Mean Data are expressed as mean ± standard deviation (n = 3). Values with different superscript letters within a row are significantly different (p < .05).. **C; snacks manufacture with wheat flour (72% ext.).**
T1; snacks manufacture with 85 % wheat flour + 15% date seed powder.,
T2; snacks manufacture with 85 % wheat flour + 15% olive seed powder.

3.5. Effect of storage on the microbial quality of the snacks

The yeast & mold and coliform counts were discovered to be absent in all the stored samples of the snacks analysed during the storage study. The significant (P<0.05) increase in the standard plate counts from 2.24 to 2.41 log cfu/g (Table 7) was detected throughout the 45

days of storage in control snacks . Addition of DSP and OSP significant (P<0.05) decrease in the standard plate counts to 2.32 log cfu/g and 2.016 log cfu/g throughout the 45 days of storage, respectively, still gathering to the limit for total bacterial count (4.70 log cfu/g) of ready to eat extruded food as agreed in BIS standards (**Patel & Modi , 2022) .**

The like growing trend in standard plate counts, while absence of yeast & molds as well as coliforms was also stated in similar snack products (**Kumar *et al*, 2020; Patel & Modi, 2022**). The overhead microbial quality directories recommend superior hygienic processes throughout food processing through manufacturing.

Table 7. Effect of storage on the microbial quality of the snack

Items	Treatments					
	C		T1		T2	
	Fresh	45 day	Fresh	45 day	Fresh	45 day
Total bacterial count log cfu/g	2.24^{c} ±0.02	2.41^{a} ±0.01	2.18^{d} ±0.02	2.32^{b} ±0.02	2.02^{e} ±0.01	2.016^{d} ±0.03
Yeast & Mould count	ND	ND	ND	ND	ND	ND
E. coli count	ND	ND	ND	ND	ND	ND

Mean Data are expressed as mean ± standard deviation (n = 3). Values with different superscript letters within a row are significantly different (p < .05)..

C; snacks manufacture with wheat flour (72% ext.).

T1; snacks manufacture with 85 % wheat flour + 15% date seed powder.,

T2; snacks manufacture with 85 % wheat flour + 15% olive seed powder

3.6. Sensory evaluation of prepared snacks

When making biscuits, **Samea & Zidan (2019),** substituted date powder for wheat flour at percentages of 5% and 10%. There were no appreciable variations between the biscuits manufactured from the various mixes of wheat flour and date powder, according to the sensory evaluation of the various snacks samples. The produced snacks' sensory rating was displayed in Table 8. The control and snack foods made with 15% olive seed had a taste rating of 9.20, whereas the snack foods made with 15% palm date seed had a taste value of 9.35. The taste values of every prepared snack were similar to one another. Oder found that snacks made with 15% palm date seed had the highest value (9.50), whereas snacks made with olive seed powder had a lower value (9.40). Between all prepared snacks, there were no appreciable variations in Oder values. Food is coloured with additional colour to minimise batch-to-batch differences, restore colour lost during processing, and colour

otherwise uncolored food. Food colouring can be divided into four categories; synthetic, organic, natural, and nature-identical **(Oplatowska-Stachowiak, & Elliott, 2017).** According to **Ray, (2021),** colour is an essential food quality factor that influences both consumer acceptance and sensory perception. These days, food manufacturers focus more on natural colours and chemicals because a lot of artificial colours and additives have been linked to harmful health impacts. It was observed that the addition of powdered date and olive seeds raised the colour values. The colour values of every prepared snack were similar to one another. Texture had the highest value in the control group (9.55). The addition of powdered date and olive seeds had an impact on texture values, which reduced as the number of tested powders was increased. This could be because the powders contain fiber. The texture values of all the prepared snacks did not differ significantly from one another. The prepared snacks' appearance was not considerably altered by the use of testing powders. All manufactured snacks were acceptable and the general appearance and acceptance did not differ much for all snacks. Such data are in line with those achieved by **(Lin, *et al.*, 2017; Samea & Zidan, 2019**).

Table 8. Sensory evaluation of prepared snacks

Characteristic	Treatment		
	C	T1	T2
Appearance	$9.35^{a} \pm 0.75$	$9.35^{a} \pm 0.49$	$9.2^{a} \pm 0.77$
Color	$9.2^{a} \pm 0.52$	$9.25^{a} \pm 0.44$	$9.3^{a} \pm 0.47$
Taste	$9.2^{a} \pm 0.70$	$9.35^{a} \pm 0.49$	$9.2^{a} \pm 0.52$
Oder	$9.45^{a} \pm 0.69$	$9.4^{a} \pm 0.60$	$9.5^{a} \pm 0.52$
Texture	$9.55^{a} \pm 0.51$	$9.2^{a} \pm 0.62$	$9.45^{a} \pm 0.51$
Overall acceptability	$9.6^{a} \pm 0.68$	$9.15^{a} \pm 0.75$	$9.35^{a} \pm 0.75$

Mean Data are expressed as mean ± standard deviation (n = 3). Values with different superscript letters within a row are significantly different ($p < .05$)..

C; snacks manufacture with wheat flour (72% ext.).

T1; snacks manufacture with 85 % wheat flour + 15% date seed powder.,

T2; snacks manufacture with 85 % wheat flour + 15% olive seed powder

Conclusion

Date seed and olive seed powders can be consumed in snacks production. Results indicated that the substituting wheat flour with date seed and olive seed powders in the manufacturing of snacks up to 15 % improved the dietary fiber & phenolic contents, organoleptic properties and the nutritional value of the produced snacks.

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