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Preparing Healthy Products Having High Nutritional Value By Using Some Food Wastes

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ABSTRACT

Agri-food industry wastes and by-products include highly valuable components that can upgraded, providing low-cost bio actives or used as an alternative healthy food source. In this context, by-products from olive and date production. This study aimed to evaluate the nutritional and sensory properties of crackers prepared using date seeds and olive stones powder. Three different substituted levels of date seeds and olive stones (10%, 20% and 30%) were used in preparing crackers. The chemical composition of them and prepared crackers were determined. Bioactive compounds in date seeds and olive stones powder were determined. Sensory properties of prepared crackers were evaluated. Results showed that the content of moisture, ash, protein, fat, fibers, flavonoids and some minerals (Fe, Ca, Na) in olive stones powder were higher than date seeds, while carbohydrates, phenols and minerals (K, Mg, Mn, Cu, Zn) content in date seeds powder were higher than olive stones powder. The study concluded that utilization of date seeds and olive stones powder improved the nutritional value of crackers.

1. Introduction

Date palm is an important plant in arid regions with more than 20 varieties reported all over the world. Date seed is a by-product of date fruit industry which is normally being discarded, used as animal feed ingredient or turned into non-caffeinated coffee by the Arabs. About 11-18% of date fruit weight is the seed (Abdul Afiq et al., 2013). The date seeds are mainly composed of dietary fiber, protein, carbohydrates, phenols, and minerals (potassium, magnesium, calcium, phosphorus, sodium, and iron). Such substances perform several functions from a biological point of view, such as antioxidant, antibacterial, and antiviral activities. Thus, utilization of such waste is very important to date cultivation and to increase the income to this sector. The good nutritional value of date seeds is based on their dietary fiber content, which make them suitable for the preparation of fiber-based foods and dietary supplements. Egypt, Saudi Arabia, and Iran were the top three producers in 2018, with nearly half the global production (Mrabet et al., 2020). The olive stone is an important by-product generated in the olive oil extraction and pitted table olive industries. As a lignocellulosic material, the hemicellulose, cellulose and lignin are the main components of olive stone as wells as protein, fat, phenols, and free sugars (Rodríguez et al. 2008). Olive stone hydrolysates may represent new ingredients with antioxidant and anti-diabetic properties for the development of nutraceuticals and functional foods for the prevention of metabolic syndrome onset (Martina et al., 2022). The world production of table olives is 2961 thousand tons (2019/2020), according to the recent international olive council (IOC) report (IOC 2021), Egypt accounted for approximately 22% of the world table olive production over that time. Demand for health -oriented products such as sugar-free, low calorie and high fiber products are increasing.

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One such recent trend is to increase the fiber content in food products to overcome health problems such as hypertension, diabetes, and colon cancer, among others. So, date seeds and olive stones can be useful materials for flour. It is assumed with semi-processed form of the equivalent protein value of wheat flour, which means it can be used date seeds and olive stones into various preparations such as cakes, breads, crackers and others. Bakery products are sometimes used as a vehicle for incorporation of different nutritionally rich ingredients (Sudha et al., 2007). Crackers are the most popular bakery items consumed nearly by all sections of the society in Egypt. This investigation was done to evaluate the nutritional and sensory properties of crackers prepared using different levels of palm date seeds and olive stones powder.

2. Materials and Methods

Materials

Egyptian Sukari date fruit variety was obtained in tamer stage from Siwa Oasis. Olive stones (Aggizi Shami cultivar) which were taken as a waste from pickling unit at Food Technology Research Institute, Agriculture Research Center, Giza, Egypt. Chemicals and reagents were obtained from Biodiognostic Company, 29 El-Tahrer Street, Dokki- Giza, Egypt.

Preparation of date seeds and olive stones powder

The date seeds were directly isolated from Sukari date. The seeds were washed to get rid of any adhering date flesh, soaked in water, and then were dried in an oven with a fan at about 50˚C for about 2 days. Date seeds were separately milled using a heavy-duty grinder into a fine powder and sieved at 72 mesh (around 210 µm). Also, olive stones were washed, dried and grind with the same way. The powder was kept in glass containers at 4°C in the refrigerator till they chemically analysis (Al-Farsi and Lee, 2008)

Preparation of date seed and olive stone crackers

The procedure for preparation of date seeds and olive stones crackers were carried out according to Bose and Shams- ud Din (2010). The wheat flour, date seeds powder ,olive stones powder and other ingredients were mixed. Water was added to form a dough. The dough was rolled to a thickness of 3mm. The crackers were cut with cutter and baked in an oven with a fan at 200°C for 10-15 min. Then they were cooled at ambient temperature and packed in high density polyethylene bags. The basic formulations of crackers were 100 g wheat flour of 72% extraction rate, 6 g vegetable oil, 2g salt, 4 g sugar, 2 g baking powder and 30 g water. Seven formulations were developed: one with wheat flour (without date seeds flour or olive stones flour) as control and six others with different proportions of date seeds powder and olive stones powder: 10%, 20% and 30% in replacement of wheat flour.

Proximate determination

Moisture, ash, protein, fat, crude fiber content was carried out according to the methods of A.O.A.C. (2005). Available carbohydrates were calculated by the following equation:

Available carbohydrate (% in dry weigh bases) =100 – (% Protein + % Fat + % Ash+% crude fiber).

The total energy was calculated according to Livesey (1995).

Total energy (kcal/100g) = [(% carbohydrates ×4) + (% protein ×4) + (% fat × 9)].

Determination of mineral contents

Minerals content (Fe, Zn, K, Ca, Na, Mg, Cu and Mn) of samples were determined according to the method outlined in AOAC (2019). Samples were processed and the minerals were analyzed. Microwave digestor (Multiwave GO Plus 50 HZ) was used prior to spectrophotometric analysis of the samples by MP-AES (Microwave Plasma -Atomic Emission Spectroscopy) (Agilent, Mulgrave, Victoria, Australia).

Determination of total phenols

The powdered of palm date seeds and olive stones were extracted with methanol, at room temperature overnight. The measurement of total phenolic contents was based with Chang et al. (2019). An aliquot (50 µL) of each extract was mixed with 1 mL of dd H_2O and

and 0.5 mL of Folin-Ciocalteu's phenol reagent. After adding 2.5 mL of 10% Na_2CO_3 solution and reacting for 20 min, the absorbance was measured at 735 nm. Standard curve was established by using Gallic acid, and the results were expressed as mg Gallic acid equivalent (GAE)/100g extract (dry weight, dw).

Determination of total flavonoids

The total flavonoids content of palm date seeds powder and olive stones powder were determined by a colorimetric method. An aliquot (250µL) of each extract was mixed with 1.25 mL of dd H_2O and 75 µL of 5% $NaNO_2$ solution and reacted for 6 min; then, 150 µL of 10% $AlCl_3 \cdot H_2O$ solution was added and reacted for another 5 min. After 0.5 mL of 1M NaOH solution and 275µL of MeOH were added to the mixture, the absorbance was read at 510 nm. A standard curve was prepared using (+) catechin; the results were expressed as mg catechin equivalent (CE)/100g extract (dw) (Liu et al., 2009).

Antioxidant Activity

DPPH Radical Scavenging Activity. An aliquot of each extract (200 µL) was mixed with 50 µL of 1Mm DPPH (prepared with MeOH) and kept in the dark for 30 min, and then the absorbance was measured by spectrophotometer (Beckman DU-7400, U.S.A) at 517nm. The test is based according to Liu et al. (2009).

Sensory evaluation

The sensory evaluation of different treatments of crackers for various attributes including color, taste, crispness, odor, and overall acceptability were carried out by 12 trained taste panel using seven hedonic score system as described by (Watts et al., 1989). On the day of evaluation, crackers from all the treatments were placed in transparent plates, labeled with random codes. Panelists were given distilled water to neutralize their mouth between the samples. The samples were presented in random order and judges were asked to rate their acceptance by giving a score for all the parameters.

Statistically analysis

Data were statistically analyzed according to Snedecor and Cochran (1980). Dancen test was analyzed.

3.Results and Discussion

Proximate composition

The proximate composition of date seeds powder and olive stones powder are summarized in Table 1. The high significant content of moisture, ash, protein, fat and crude fibers were shown in olive stones powder, which contain the lowest amount of carbohydrates (64.52 g/100 g DW). The lowest contents of moisture, ash, protein, fat and crude fibers were in date seeds powder, which contain the highest amount of carbohydrates (72.31 g/100 g DW). These results of proximate composition are close to those reported by Ahfaiter et al. (2018), Jahanbakhshi and Ansari (2020) and Valvez et al. (2021).

Table 1. Chemical Composition of date seeds and olive stones powder as (% on dry weight)

Sample	Moisture	Ash	Protein	Fat	Crude fibers	Available carbohydrate
Date seeds powder	4.29 ± 0.12^b	0.90 ± 0.02^b	3.84 ± 0.12^b	5.43 ± 0.45^b	17.52 ± 0.42^b	72.31 ± 0.21^a
Olive stones powder	10.18 ± 0.47^a	1.81 ± 0.16^a	5.35 ± 0.31^a	7.49 ± 0.12^a	20.82 ± 0.31^a	64.52 ± 0.38^b

Each value is a mean of three replicates values are means ± SD.
Values in the same column followed by the same letter are not significantly different at $p < 0.05$

Minerals content of date seeds and olive stones powder

Table 2. showed the minerals content in palm date seeds and olive stones powder as (ppm). Date seeds powder contained higher amounts of Zn, K, Mg, Cu and Mn (5.56, 2741, 517, 8.14 and 6.67 ppm.), respectively than olive stones. Olive stones contained higher amounts of Fe, Ca and Na (34.32, 1300 and 332.04 ppm.), respectively. These results agreed with Bouhlalia et al. (2017) and Eid (2021).

Table 2. Mineral composition of date seeds and olive stones powder as (ppm)

Sample	Fe	Zn	K	Ca	Na	Mg	Cu	Mn
Date seeds powder	21.3	5.56	2741	340.4	165.4	517	8.14	6.67
Olive stones powder	34.32	4.35	2300	1300	332.04	248.12	4.35	1.03

Bioactive compound of date seeds and olive stones powder

Table 3. showed the bioactive compounds content of date seeds and olive stones powder as (mg/100g.). Results indicated that date seeds powder recorded high significant amount of total phenolic content (3106.26mg/100g.) than olive stones powder, while olive stones powder contained higher amount of total flavonoids content and antioxidant activity (90.26 mg/100g and 251.7%), respectively. These results are close to those reported by Ahfaiter et al. (2018). The correlation between the phenolic content in pulp and seed can help to evaluate the possibility of new uses of the whole fruit, and in particular, of the seed recovered from the pit a, by-product of the production of virgin olive oil, from de-stoned olives but also from pitted table olives and showed that the dried stone extracts are a rich source of total phenols, this data agreed with (Lorenzo, et al., 2023) .The olive fruit, leaf, and seed extracts have remarkable antioxidant, antimicrobial, and antithrombotic potential but the seed extract had the highest phenolic content (Kadir, et.al., 2023). The total phenolic content of olive stone was 219.78 mg/100g. These data of analysis confirm previous results reported by (Younis, et al., 2023) who found that total phenol and flavonoids contents were (276 mg/100g and 93 mg/100g), respectively.

Table 3. Bioactive compound of date seeds and olive stones powder

	date seeds powder	olive stones powder
Antioxidant activity DPPH (%)	245.53±5.45^{b}	251.7±8.19^{a}
Total phenolic content (mg GAE/100 g DW)	3106.26±13.04^{a}	219.78±2.64^{b}
Total flavonoids content (mg CE/100 g DW)	22.81±1.95^{b}	90.26±3.52^{a}

Each value is a mean of three replicates values are means ± SD.
Values in the same row followed by the same letter are not significantly different at $p < 0.05$

Sensory evaluations of crackers samples supplemented with date seeds and olive stones powder

Table 4. represented the sensory properties (odor, taste, crispness, color and overall acceptability) of crackers with different concentrations of date seeds and olive stones powder. According to the total sensory scores, the samples exhibited great acceptable sensory characteristics. Control sample was observed to have the highest level of acceptance. There were no significant effected with control and 10% olive stones powder crackers in odor and taste. The panelist preferred the crackers with 10% and 20% olive stones powder, and they like the crackers with 10% date seeds. The addition of higher content (30%) in the formulation had negative effects on the color, odor, taste, and overall acceptability as compared to the regarding samples. Date seeds flour (10% and 20%) incorporated crackers exhibited a high acceptance score for texture and taste. Intensity of the color increased with increasing percentage of date seeds flour Ahfaiter et al. (2018). Bolek (2020) said that the level of substitution increased, the color of biscuit turned from light brown to dark brown, leading to lower acceptance. The texture values of biscuit sample increased significantly with an increase in proportion of olive stone powder. This result revealed that wheat flour could be substituted up to 20% by date seeds or olive stones powder to prepare crackers without causing unacceptable product in terms of sensory properties.

Effect of various level of date seeds and olive stones powder on the composition of cracker

The composition of cracker was prepared by incorporating various level of date seeds and olive stones powder, the results were presented in Table 5. The addition of date seed and olive stone powder affected the composition of cracker biscuits. Increasing the levels of these materials resulted in higher moisture, ash, fat, and crude fiber content, but a reduction in protein and total carbohydrate levels. Biscuits are the most popularly consumed bakery items in the world. Nowadays, incorporation of new ingredients in the traditional biscuit is a promising strategy to develop healthy and nutritious bakery products in food industry. Previous studies have demonstrated that addition of fiber rich ingredients in biscuit can improves nutritional quality of biscuit (Xing-jiang et al. 2017). In this study also observed that control crackers contained 0.73% crude fiber, whereas crackers containing 10% date seeds or olive stones powder contained 1.64% and 2.08% crude fiber, biscuit containing 20% date seeds and olive stones powder contained 2.27% and 3.48% crude fiber and crackers containing 30% date seeds or olive stones powder contained 3.6% and 3.85% crude fiber respectively. Then, it was concluded that, increased the level of crude fiber with the increasing the amount of incorporated date seeds and olive stones powder can be as a good source of dietary fibers, phenolic component, flavonoids and natural antioxidant, which can be further developed into new products or already existing products. The use of date seeds and olive stones in fiber-based foods and dietary supplements are suggested due to the excellent content of dietary fiber (Eid et al., 2021, Ahfaiter et al., 2018). Table 5. also showed the caloric value of cracker biscuits according to nutrient sources (kcal./100g). Total k. calories ranged from 442.67 to 449.23 k. calorie regarded to calories of protein, fat and carbohydrates. The decrease in carbohydrate content as the supplementation with date seeds and olive stones powder increased may be due to the low carbohydrate content in them. These results are similar to those of (Elfeky et al., 2023). The highest values of total carbohydrate and total energy were observed in the control sample.

Table 4. Sensory evaluation of prepared crackers

Formula	Odor (10)	Taste (10)	Crispness (10)	Color (10)	Overall acceptability (10)
control	9.67± 0.29^{a}	9.67± 0.29^{a}	9.0±0.50^{a}	9.50±0.50^{a}	9.17±0.29^{a}
10% date seeds powder	8.83± 0.29^{b}	8.50± 0.50^{b}	8.33±0.58^{b}	8.17±0.29^{b}	8.50±0.50^{b}
20% date seeds powder	7.67± 0.29^{d}	7.17± 0.29^{c}	7.0±0.50^{c}	7.17±0.29^{c}	7.33±0.29^{c}
30% date seeds powder	5.0± 0.50^{e}	6.33± 0.76^{d}	6.67±0.29^{c}	4.67±0.29^{e}	5.17±0.76^{e}
10% olive stones powder	9.50±0.50^{a}	9.17±0.29^{a}	8.50±0.50^{b}	8.33±0.58^{b}	8.33±0.58^{b}
20% olive stones powder	8.17±0.76^{c}	8.17±0.29^{b}	7.50±0.50^{c}	7.67±0.58^{c}	7.50±0.50^{c}
30% olive stones powder	7.17±0.29^{d}	7.17±0.58^{c}	6.83±0.29^{c}	6.83±0.29^{d}	7.0±0.50^{d}

Each value is a mean of three replicates values are means ± SD.
Values in the same column followed by the same letter are not significantly different at $p < 0.05$

Table 5. Chemical Composition and caloric values of prepared crackers

samples	Moisture	Ash	Protein	Fat	Crude fibers	Available carbohydrate	Total k. calories
Control	6.01± 0.13$_{d}$	2.04± 0.18^{c}	9.32± 0.09^{a}	12.07± 0.14^{c}	0.73± 0.06^{d}	75.83± 0.34^{a}	449.23^{a}
10% date seeds powder	7.22± 0.28^{c}	1.98± 0.23^{c}	8.96± 0.17^{b}	12.11± 0.11^{c}	1.64± 0.05^{c}	75.27± 0.36^{a}	445.91^{b}
20% date seeds powder	8.39± 0.21^{b}	2.20± 0.14^{b}	8.36± 0.09^{c}	12.42± 0.31^{b}	2.27± 0.08^{b}	74.75± 0.46^{a}	444.22^{b}
30% date seeds powder	10.86± 0.46^{a}	2.34± 0.08^{b}	7.90± 0.12^{d}	12.82± 0.23^{b}	3.06± 0.17^{a}	74.21± 0.91^{b}	443.82^{c}
10% olive stones powder	6.24± 0.26$_{d}$	2.27± 0.19^{b}	9.09± 0.14^{b}	12.74± 0.15^{b}	2.08± 0.12^{b}	73.70± 0.70^{b}	445.82^{b}
20% olive stones powder	6.47± 0.32$_{d}$	2.58± 0.14^{a}	9.05± 0.13^{b}	13.43± 0.41^{a}	3.48± 0.17^{a}	71.42± 0.35^{c}	442.75^{c}
30% olive stones powder	6.66± 0.41$_{d}$	2.77± 0.09^{a}	8.49± 0.37^{c}	13.88± 0.18^{a}	3.85± 0.06^{a}	70.94± 0.82^{c}	442.67^{c}

Each value is a mean of three replicates values are means ± SD.
Values in the same column followed by the same letter are not significantly different at $p < 0.05$

4. Conclusion

From the obtained results, it could be concluded that using date seeds and olive stones powder in preparing cracker biscuits led to improving the nutritional value of biscuits as it considered a good source of fibers, fats and minerals. The addition of increasing levels of date seeds or olive stones powder in the cracker biscuits affected the quality attributes. However, considering various baking quality and sensory attributes, it has been found that 10% date seeds and olive stones powder could be incorporated in the formulations in order to produce cracker biscuits with acceptable quality.

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