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"Evaluation of Antioxidant, Anti-Inflammatory, and Anticancer Activities of Palm Heart (*Phoenix dactylifera* L.) In Vitro"

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ABSTRACT

This study assessed the chemical composition of palm hearts (*P. dactylifera*, var., Zaghloul), locally called "Al-Guomar," and their ethanolic extract's effect as an antioxidant, anti-inflammatory, and anticancer in vitro using Hela and Mcf7 breast cancer cells. Palm hearts were high in fiber, protein, and carbohydrates. The extract contained 37.7 mg QE/g of total flavonoids and 79.6 mg GAE/g of total phenols. Using the 1,1-diphenyl-2-picryl hydrazyl (DPPH) test, the antioxidant activity of the ethanolic extract was determined. DPPH scavenging activity was maximum at 73.19% and 67.68%, respectively, for the extract concentrations of 1000 µg/mL and 500 µg/mL, whereas the IC_{50} value was 73.97 µg /ml. Because the ethanolic extract significantly decreased red blood cell hemolysis, it had an anti-inflammatory impact. At 1000 µg/mL, the maximum percentage of inhibition was achieved, which was 93.9%. In human cell lines of breast cancer (Mcf7) and cervical cancer (Hela), the extract lowered cells' viability in a concentration-dependent manner. Compared to the control, it also significantly altered the morphology of the cells. Therefore, it is recommended that palm heart "Goumar" be consumed either fresh or in food products to prevent some cancers.

Keywords: palm heart, anticancer, anti-inflammatory, breast cancer, cervical cancer

INTRODUCTION

The date palm (*P. dactylifera* L.), is one of the earliest cultivated plants known to man, and it has been consumed as food for nearly 6000 years (Sahari *et al*., 2007). The date palm is a key component of Egypt's reclamation efforts and the country's agricultural sector. Egyptians use date palm byproducts daily in addition to the fruits' nutritional value and health advantages. The date palm's ability to withstand drought made it one of the first fruit plants to be introduced and grown in Egypt's semi-arid and desert regions. Even though Egypt has a large number of date varieties, only roughly twenty are commercially available (Bekheet, 2013).

Egypt is covered in date palm trees that run from Alexandria in the north to Aswan in the south, and from the Red Sea in the east to the New Valley and the Oases in the west. Furthermore, date palm trees are thought to be the most fruitful tree to grow on the recently reclaimed soil in the areas of Toshki, El-Ewinates, and Sinai. Twelve million of the sixteen million palm trees that are planted in Egypt are fruiting trees (FAOSTAT, 2009). There are three categories for Egyptian date palm cultivars: semi-dry, dry, and soft dates. They tend to restrict themselves to specific areas where they thrive more than in other places. The marine subtropical district (Nile Delta) is generally where soft date cultivars are grown; semi-dry cultivars are most common in the Oases, and the Aswan governorate is home to dry varieties (Bekheet, 2013). They are a great source of vitamins and dietary fiber that may be included in any balanced diet (Shimizu *et al*., 2011).

The term "palm heart" pertains to date palm stem cells that are taken from shoots that emerge from the palm head or main branch that is clothed in broad leaves. Typically, young trees (4-5 years old) are used to produce it. it is a white, cylindrical food is edible (Movahed *et al*., 2012). It is called by many names, such as the heart of palm trees, as well as palmetto and guomar. Despite being used less than edible palm goods, the heart of the palm is nevertheless a significant component of the food business, unlike most palm products (Salvi and Katewa, 2014).

The guomar is the central upper part of the growing top of the palm tree, and it is a newly formed tissue, white, ivory in color, fragile and sweet, weighing more than a kilogram, cut into slices and eaten. Its flavor remains for more than two weeks, provided that it is wrapped in plastic bags and refrigerated immediately after harvest. The guomar is classified as fresh, prepared and manufactured vegetables (canned). It can be divided into three parts: the base, the cylinder, and the free top, all of which are edible (Masoomeh *et al*., 2013). Some people like to eat it raw, in salads or cooked in soups, and other foods in various ways (Trabzuni *et al*., 2014). It provides humans with sugars, fats, protein, mineral salts, vitamins, and fibers (Ghalib, 2004).

Palm's heart is obtained from many genera and species of palm trees (Soto *et al*., 2005). The palm's apical meristem and a portion of the immature or young leaves that emerge from it make up the heart of the palm. This edible meristem is commonly used in soups, salads, and other upscale cuisine (Tabora *et al*., 1993). As soon as this product is extracted from the tree, people consume it fresh. According to Pollak *et al*. (1995), tropical countries may find value in the nontimber forest product known as palm heart for their economies. Ecuador is the top exporter of palm hearts worldwide, followed by Costa Rica and Brazil (Shimizu *et al*., 2011). With 17 amino acids, hearts of palm

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have a comparatively high protein content (2.27% to 2.81% in fresh weight). The heart of the palm contains every necessary amino acid. Another excellent food source of dietary fiber is hearts of palm. They provide moderate minerals, including K, Na, P, Zn, Fe, and Ca. Still, they are minimal in sugar and fat (Tabora *et al*., 1993).

Fruits and vegetables contain nutrients, including vitamins and minerals, as well as non-nutritive components like fiber and phenolic chemicals linked to biological and advantageous health impacts in both test animals and humans. The risk of chronic diseases like cardiovascular disease, cancer, diabetes, and age-related functional decline is also significantly lowered when fruits, vegetables, and whole grains are consumed regularly (Yeh and Yen, 2005). Palm heart is considered a great source of protein. Additionally, due to its high crude fiber and low-fat content, it can be used as a vegetable salad and an excellent nutritional supplement, especially for people with cardiovascular illnesses. In particular for diabetic individuals, palm hearts can be introduced as a cholesterol-free, nutrient-dense diet essential for promoting bowel movements and preventing blood sugar levels from rising (Sourki and Rahmanian, 2019).

The phenolic substances such as gallic acid, catechin, epicatechin, ellagic acid, myricetin, quercetin, kaempferol, resveratrol, and anthocyanin may be responsible for some date palm pits' inhibitory lipase action so that it might be helpful in the management or prevention of obesity. The date palm fruit's meat and pit extracts have free radical scavenging properties; nevertheless, the considerable effect of palmito extract after two weeks on serum total lipid levels could be attributable to the antioxidant properties of palmito extract (Chaira *et al*., 2007). The palm heart works to prevent anemia because it is rich in iron and contains vitamin A. It also contains calcium and fibers that improve the digestive system's work, preventing constipation and indigestion and helping to excrete toxins outside the body (Salvi and Katewa, 2014). It's linked to additional advantages, including reduced inflammation and enhanced urination. Additionally, it protects the liver, kidneys, and stomach (Baliga *et al*., 2011).

The side effects of chemotherapy for breast cancer and other cancers will worsen for the patient (Mjali *et al*., 2018). Therefore, to stop breast cancer from developing and to avoid the challenges of chemotherapy, non-toxic and edible medicinal plants can be used regularly (Ümit *et al*., 2017). Aminah *et al*. (2013) stated that an aqueous crude extract of date palm pith (*P. dactylifera* cultivar. Zahdi) was studied for its impact on the proliferation of two cancer cell lines, namely Human Rhabdomyosarcoma -RD and Glioblastoma – ANG. Various extract concentrations (1250,2500,5000,10000) µg / ml were taken, and the extract's efficacy was evaluated. The outcome indicated that the two cell lines (RD, ANG) were cytotoxically affected by the aqueous crude extract of date palm pith.

This investigation sought to ascertain the chemical compositions, total phenols, total flavonoids, antioxidant activity, and anti-inflammatory and anticancer properties of an ethanol extract of palm heart (*P. dactylifera*, var., Zaghloul) in vitro.

MATERIALS AND METHODS

Materials:

Palm heart: Goumar samples (*Phoenix dactylifera*, var., Zaghloul) were obtained in March 2023 from local market of Alexandria city, Egypt. Staff of the Department of Pomology, Faculty of Agriculture, Mansoura University kindly confirmed the palm heart identity.

Ethics approval: The protocol of this study was approved by the research ethics committee of the Faculty of Specific Education at Mansoura University (No 29 nutrition, 1-3-2024)

Methods:

Preparation of palm heart powder and ethanolic extract:

Powder: Samples of date palm heart (Al-Goumar) were carefully peeled to minimize tissue loss. Goumar was washed well under running tap water to remove impurities and then dried with blotting paper. After that, it was grated and laid out to dry in the shade on a solid surface for twelve hours, then dried in an air oven at 50 C. After the dry material was ground until it could pass 60 mesh sieves, the flour was bagged up and stored at 4˚C until further analysis could be performed.

Extract: 500 g of dried goumar were macerated in 500 ml of ethanol overnight and filtered. The residue was resoaked in ethanol and filtered twice. The filtrate was collected and subjected to evaporation using a rotary evaporator to obtain the extract. It was then allowed to dry in a desiccator over anhydrous $CaCl_2$ until it reached a constant weight (Elbadrawy and Mostafa, 2024).

Gross chemical composition:

Moisture, ash, crude fiber, crude protein and lipids were determined using the methodology of (A.O.A.C., 2019).

Using the following equation, the difference was employed to calculate the amount of carbohydrates:

% Carbohydrates = 100 - (Moisure% + Protein% + Lipids% + Ash%).

Total phenol and total flavonoid contents determination:

Using the Folin-Ciocalteau reagent, the polyphenol content was measured by Xu and Chang (2007). Using the Gallic acid standard curve, the total phenol content of the test samples was determined and represented as mg GAE/100mg sample. The colorimetric aluminum chloride method of flavonoid detection was utilized. Using the standard plot as a guide, the total flavonoid content of the test samples was determined and reported as mg QE/100 mg sample.

Determination of phenolic compound:

HPLC analysis was performed using the method of Goupy's *et al*., (1999) method.

Evaluation of antioxidant activity by DPPH radical scavenging method:

Using 1, 1-diphenyl-2-picryl hydrazyl (DPPH), the free radical scavenging capacity of several plant leaf extracts was assessed. To put it briefly, a 0.1 mM DPPH solution in ethanol was made. Three millilitres of various extracts in ethanol at varying concentrations (1.9, 3.9, 7.8, 15.62, 31.25, 62.5, 125, 250, 500, and 1000 µg/ml) were mixed with one millilitre of DPPH solution. Only extracts that dissolve in ethanol are employed here, and the dilution procedure was used to create the various concentrations of the extracts. After giving the mixture a good shake, it was let to stand at

room temperature for half an hour. After that, the absorbance at 517 nm was measured with a UV-VIS Milton Roy spectrophotometer. The experiment was run in triplicate using ascorbic acid as the reference standard component. The sample's IC_{50} value, or the concentration required to inhibit 50% of the DPPH free radical, was found using the log dosage inhibition curve. Reduced absorbance in the reaction mixture indicates higher levels of free radical activity (Patel and Patel, 2011).

To determine the percentage DPPH scavenging effect, the following calculation was used:

Percent inhibition = A0 – A1/A0 × 100,

Where

A0 was the absorbance of the control reaction and A1 was the absorbance of the extracted samples or the standard sample

In vitro anti-inflammatory assay:

Preparation of erythrocyte suspension: Three milliliters of blood from three good-health volunteers were collected into heparinized tubes and centrifuged for ten minutes at 3000 rpm. The supernatant was diluted with the same volume of regular saline to dissolve the red blood pellets. Red blood pellets that had dissolved were measured for volume and reconstituted as a 40% v/v suspension in an isotonic buffer solution (10 mM sodium phosphate buffer, pH 7.4), subsequently used as the erythrocyte suspension.

Hypotonicity-induced hemolysis: Samples of the extract utilized in this investigation were diluted in distilled water in a hypotonic solution. Duplicate pairs (per dose) of centrifuge tubes were filled with the hypotonic solution (5 ml) with increasing dosages of the extracts (100, 200, 400, 600, 800, and 1000 µg/ml). Additionally, a 5-milliliter isotonic solution containing graded doses of the extracts (100–1000 µg/ml) was added to duplicate pairs (per dose) in centrifuge tubes. The control tubes contained five millilitres of indomethacin at a concentration of 200 µg/ml and the vehicle, which was distilled water. Each tube received 0.1 ml of erythrocyte suspension, which was added and adequately mixed in. Following an hour of incubation at room temperature (37°C), the solutions underwent a three-minute, 1300 g centrifugation. The absorbance (OD) was determined by measuring the supernatant's hemoglobin concentration at 540 nm using a Spectronic (Milton Roy) spectrophotometer. Assuming all hemolysis was produced with distilled water present, the percentage of bleeding was computed.

The extract's percentage of hemolysis inhibition was computed as follows:

% Inhibition of hemolysis = 1 – ((OD2 – OD1)/ (OD3 – OD1)) * 100,

where

OD1 = absorbance of the extracted sample in the isotonic solution,
OD2 = absorbance of the extracted sample in the hypotonic solution and
OD3 = absorbance of control sample in the hypotonic solution.

Effect of palm heart ethanolic extract on Mcf7 and Hela cells:

The ethanolic extract of palm heart was tested for its cytotoxic effect against Mcf7 and Hela cells using the cell viability and proliferation assay (MTT). The procedure followed van de Loosdrecht *et al.*'s (1994) recommendation and used a 96-well culture plate.

To create a full monolayer sheet, 1 X 105 cells/ml (100 ul/well) were added to a 96-well tissue culture plate and incubated for 24 hours at 37°C. The growth material was taken out of the 96-well microtiter plates once a confluent sheet of cells had grown, and the cell monolayer was twice washed with wash media. After being diluted twice, the test sample was put in maintenance medium (RPMI medium) containing 2% serum. A total of three wells were used as controls, receiving just maintenance media, and each dilution was evaluated in increments of 0.1 millilitre in multiple wells. The plate was incubated at 37°C before testing. Physical indicators of toxicity, such as shrinkage, rounding, granulation, or partial or whole loss of the monolayer, were examined in the cells. A 5 mg/ml MTT solution was made in PBS (BIO BASIC CANADA INC). For every well, 20ul of MTT solution was used. Each well received 20 µL of MTT solution (5 mg/mL), which was then combined with the medium using a shaking table set at 150 rpm for five minutes. After that, the MTT underwent metabolization for one to five hours at 37°C and 5% CO2. Subsequently, the medium was disposed of, and if required, the plate was dried using a paper towel to eliminate any leftover residue. Next, we combined the formazan, a metabolic by-product of MTT, with the solvent for five minutes at 150 rpm after reconstituting it in 200 µL of dimethyl sulfoxide. The optical density was measured at 560 nm, and the subtracted background was detected at 620 nm. There was a direct relationship between optical density and cell count.

Statistical analysis:

The mean ± SD of the data was displayed. As stated by McCormick and Salcedo (2017), every test was analyzed through the statistical analysis application SPSS. (Version 24).

RESULTS AND DISCUSSION

Proximate chemical analysis of palm heart:

The chemical composition of the palm heart (*P. dactylifera*, var., Zaghloul) is presented in Table 1 after oven drying at 50°C. It contained 8.74% moisture, 23.08% protein, 3.73% ash, 0.56% fat, 5.50% fiber, and 58.39% carbohydrates.

Table 1. Gross chemical composition of palm heart (% on a dry weight basis).

Components	Moisture	Protein	Ash	Fat	Total carbs.	
					fiber	Carbs.
Chem. Comp.	8.74±0.10	23.08±0.21	3.73±0.11	0.56±0.08	5.50±0.15	58.39±0.61

Each value is the mean ± SD

With 17 amino acids, hearts of palm have a comparatively high protein content (2.81% to 2.27% in fresh weight). Palm heart contains all the essential amino acids. Another great food source of dietary fiber is hearts of palm. Still, they are minimal in sugar and fat (Tabora *et al.,* 1993).

Sukkari's heart palm had the most excellent protein content on wet weight (2.57%). The heart of an Iranian variety date palm had a low protein value of 1.06%, according to Movahed *et al.* (2012). Sukkari, Sollag, and Naboat Saif's fat levels (dry weight basis) were more than Simas *et al.*'s (2010) result for King Palm flour (0.91%). Trabzuni *et al.* (2014)

state that moisture, which ranges from 80.44% to 82.82%, is the main component of the fresh samples. Sukkari, Sollag, and Naboat Saif's ash contents stated on a dry weight basis were 42.82%, 42.90%, and 37.88%, respectively. The product's mineral composition is reflected in its ash content. High correlations ($P < 0.001$) were seen by Leterme *et al*. (2006) between total ash and the majority of the macro- and micro-mineral concentrations they examined in a variety of fruits and unusual foods. In terms of dry weight basis, the carbohydrates component is substantial for all three samples (41.52% - 50.92%). Fiber makes up most of the carbohydrates in the heart of the palm (Movahed *et al*. 2012). Most research has been done on the health advantages of consuming foods high in fiber (Mälkki, 2001).

Total phenols and total flavonoids in palm heart ethanolic extract:

The main plant compounds with antioxidant properties are polyphenols. These may be found in most plants and are thought to offer protection against damage caused by free radicals in many ways, such as by directly scavenging free radicals and inhibiting the enzymes that cause free radical formation (Xu *et al*., 2017; Hassan *et al*., 2017; Hameed *et al*., 2021). Table 2 shows the total phenols and flavonoids in the ethanolic extract of palm heart (*P. dactylifera*, var., Zaghloul). The phenol content was 79.6 mg GAE/g, while the total flavonoid content was 37.7 mg QE/g. These findings corroborated those of Sahyon and Al-Harbi (2020), who discovered that the HP extract's polyphenol concentration was 32.5 ± 0.92 GAE/100 g FW.

Table 2. Total phenols and flavonoids of palm heart ethanolic extract.

T. phenols	79.6 mg GAE/g
T. flavonoids	37.7 mg QE/g

Phenolic compounds of palm heart ethanolic extract :

Table 3 and Fig. 1 show that the palm heart ethanolic extract (*P. dactylifera*, var., Zaghloul) contained 85.69 mg/g gallic acid, 108.85 mg/g chlorogenic acid, 70.63 mg/g catechin, 34.83 mg/g methyl gallate, 132.38 mg/g caffeic acid, 13.25 mg/g syringic acid, 136.22 mg/g rutin, 46.34 mg/g ellagic acid, 3.03 mg/g coumaric acid, 3.16 mg/g vanillin, 5.71 mg/g ferulic acid, 6.07 mg/g naringenin, 0.66 mg/g daidzein, 15.76 mg/g quercetin, 2.89 mg/g cinnamic acid, 1.57 mg/g Apigenin and1.74 mg/g Kaempferol. The results indicate that the principal phenolic components found in the ethanolic extract of palm hearts were gallic acid, rutin, caffeic acid, and chlorogenic acid.

The fruits of the *P. dactylifera* tree are high in polyphenols according to recent studies (Abu-Reidah, 2017; Boucenna-Mouzali, 2018). The primary food source for date fruits is the head of the P. dactylifera tree. Terpenes and polyphenols abound in the heart of *P. dactylifera* extract, according to prior research. More polyphenols than those previously documented in date fruit were discovered in the HP extract, including gallic acid, chlorogenic acid, caffeic acid, syringic acid, coumaric acid, ferulic acid, and cinnamic acid. The significant antioxidant effects of palm heart extract are attributed to these terpenes and polyphenols (Sahyon and Al-Harbi, 2020)

Table 3. Phenolic compounds of palm heart ethanolic extract.

Phenolic compound	Conc.(mg/g)
Gallic acid	85.69
Chlorogenic acid	108.85
Catechin	70.63
Methyl gallate	34.83
Coffeic acid	132.38
Syringic acid	13.25
Pyro catechol	0.00
Rutin	136.22
Ellagic acid	46.34
Coumaric acid	3.03
Vanillin	3.16
Ferulic acid	5.71
Naringenin	6.07
Daidzein	0.66
Querectin	15.76
Cinnamic acid	2.89
Apigenin	1.57
Kaempferol	1.74
Hesperetin	0.00

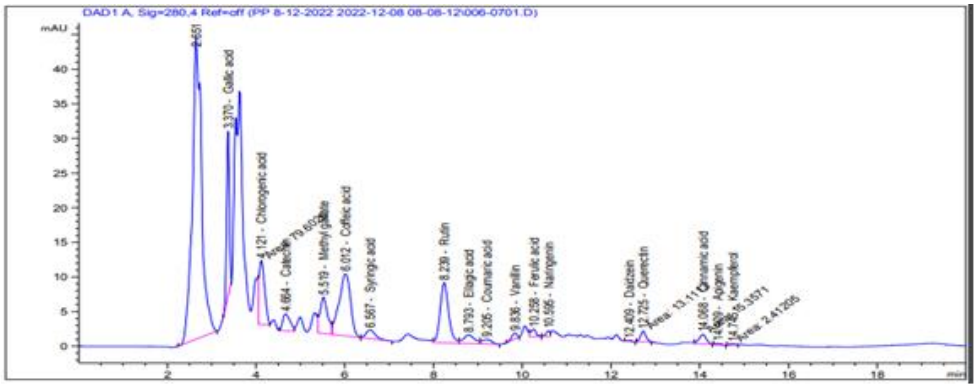

Fig. 1. Phenolic compounds of palm heart ethanolic extract.

Regarding phenolic substances, numerous factors, including environmental circumstances, climate, temperature, humidity, other growth factors, geographic origin, fertilizer, soil type, amount of sunlight, processing techniques, and storage conditions, can be blamed for variations in date fruit from different types (Al-Farsi *et al*., 2007; Kchaou *et al*., 2013; Mansouri *et al*., 2005)

Antioxidant activity of palm heart ethanolic extract, DPPH assay:

Lipids and other molecules can be prevented or delayed from oxidizing by antioxidants present in medicinal plants. The oxidation process has been connected to chronic illnesses like cancer because it has been shown that a number of lipid-oxidation products interact with biological elements and damage cells. Antioxidant studies have shown that certain parts

of the *P. dactylifera* tree are vital; dates, for instance, are considered a rich source of antioxidants because of their carotenoids and phenolics (Siddiqi *et al*., 2020)

Using the 1,1-diphenyl2-picryl hydrazyl (DPPH) assay, the antioxidant activity of the palm heart ethanolic extract (*P. dactylifera*, var., Zaghloul) was determined. Table 4 and Fig. 2 demonstrate how the DPPH scavenging % rose in tandem with the extract concentration. The maximum DPPH scavenging activity was 73.19% at 1000 µg/mL extract concentrations. High levels of DPPH scavenging activity were also seen at 500 and 250 µg/mL, reaching 67.68 and 61.25%, respectively. The antioxidant's IC_{50} value is the amount required to lower the starting DPPH concentration by 50%. Antioxidant activity is high when the IC_{50} is low. The palm heart has high antioxidant activity, as seen by the results, which demonstrate that the IC_{50} was quite low at 73.97 µg/mL.

The effectiveness of *P. dactylifera* as a natural antioxidant has been demonstrated by numerous investigations. *P. dactylifera* L. date seeds possess the capacity to be a valuable source of bioactive substances that have both antioxidant and enzyme-inhibitory properties., according to research by Quarda *et al.* (2019). Date phenolics and flavonoids from the Amar and Hillawi varieties show a tight structural activity as antioxidants and anti-atherogenic, according to research by Hamutal *et al.* (2015).

According to the study of Hameed *et al*. (2021), the DPPH test method proved that When *P. dactylifera* (Hillawi variety) heart extract is compared to vitamin C as a reference, it shows good antioxidant activity. The actions of heart extract related to its chemical composition may be responsible for its scavenging effect (The hydroxyl group is essential for the levels of antioxidant scavenging). Consequently, heart extracts may have antioxidant properties due to the ratio of phenolic and flavonoid compounds. However, Sahyon and Al-Harbi (2020) discovered that the DPPH IC_{50} of the heart of palm extract was equal to 605.7µg /ml. The high phenolic content of palm hearts likely gave them their antioxidant activity.

Table 4 Antioxidant activity of palm heart ethanolic extract, DPPH assay.

Concentration (µg/mL)	DPPH scavenging%	
	Standard ascorbic acid	Sample
1.95	41.75a±0.52	17.37b±0.42
3.9	45.85a±0.15	25.07b±0.12
7.8125	56.27a±0.23	30.81b±0.27
15.625	64.22a±0.31	35.64b±0.38
31.25	71.20a±0.23	40.64b±0.18
62.5	77.97a±0.37	47.96b±0.09
125	86.43a±0.35	54.73b±0.15
250	92.66a±0.29	61.25b±0.10
500	94.51a±0.25	67.68b±0.25
1000	97.20a±0.30	73.19b±0.24
IC_{50}	4.08 µg /ml	73.97 µg /ml

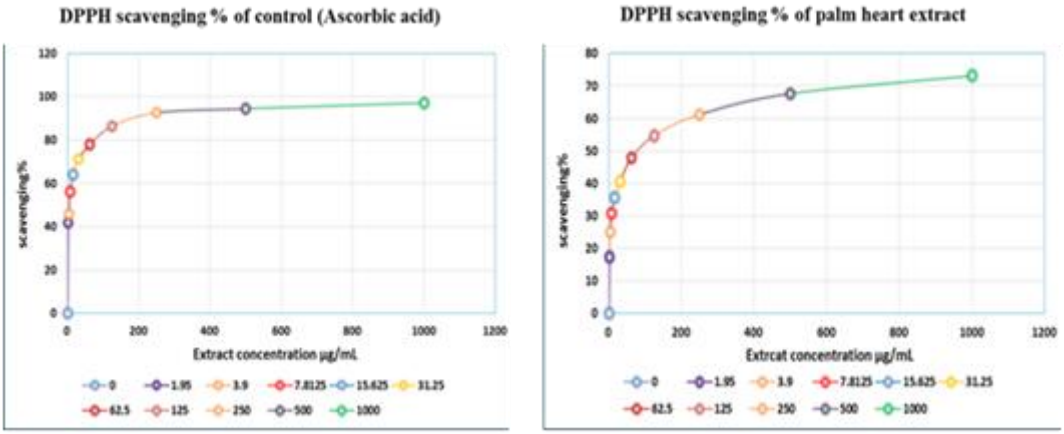

Fig. 2. DPPH scavenging % of palm heart ethanolic extract.

Anti-inflammatory activity of palm heart ethanolic extract:

Synthetic anti-inflammatory medications were once utilized to treat inflammations and associated conditions. However, they are no longer safer and have several negative side effects (Lanas, 2009; Kandulski *et al*., 2009). The plants have active phenolic chemicals that promote health and function as effective anti-inflammatory medicines (Talhouk *et al*., 2007). Consequently, switching to medicinal plant therapy instead of synthetic medications proves to be an effective and safer substitute. Furthermore, while plant extract therapy has multiple active molecules that work in concert to target complex pathways, manufactured medications only contain one active component that targets one specific path (Kumar *et al*., 2013).

We employed the in vitro HRBC (human red blood cell) method to examine the anti-inflammatory characteristics of the palm heart ethanolic extract (*P. dactylifera*, var., Zaghloul). The process indicates that the lysosomal and erythrocyte membranes are comparable. Therefore, the extract from the palm heart may stabilize the lysosomal membrane by stabilizing the erythrocyte membrane. Table 5 demonstrates that the hemolysis of red blood cells was significantly reduced at all extract dosages; at 1000 µg/mL, the highest inhibition percentage was 93.9%. Moreover, the 800 and 600 µg/mL concentrations demonstrated substantial levels of inhibition percentage, reaching 79.1 and 61.2%, respectively.

As the extract concentration was lowered, the inhibition percentage decreased as well. Thus, the palm heart extract demonstrated anti-inflammatory qualities in the test subjects under study. Red blood cells undergo hemolysis in the hypotonic solution due to fluid building up inside the cells and rupturing their membranes. Free radicals increase the injured red blood cells' susceptibility to lipid oxidation. This leads to the entry of certain substances, such as fluids and protein, into the tissues, comparable to inflammation (Halliwell and Whiteman, 2004).

This study found that the ethanolic extract of the palm heart (*Phoenix dactylifera*, var., Zaghloul) contained flavonoids, which are well-known for their anti-inflammatory qualities because they can inhibit the enzymes involved in the metabolism of arachidonic acid and the enzymes that lead to the production of inflammatory mediators (Halliwell *et al*., 2005; Oweyele *et al.*, 2005; Metowogo *et al*., 2008).

Because of their possible uses in the food, pharmaceutical, and chemical industries, bioactive phenolic compounds have received more attention in recent years when extracted from natural sources. It has been demonstrated that these phenolic compounds have anti-mutagenic, anti-inflammatory, and antibacterial qualities. They also appear to reduce the risk of cardiovascular disease, diabetes, and cancer (Parvathy *et al*., 2009; Saleh *et al.*, 2018; Abdel-Aty *et al*., 2019a; Abdel-Aty *et al*., 2019b).

The date palm seed extract's phenolic compounds have a strong ability to suppress LPS-induced inflammation at both the iNOS activity (NO release) and protein expression levels, according to a recent study by Bassuiny and. Abdel-Aty (2020). This finding suggests that the compounds from the studied extracts may find use in anti-inflammatory formulations. The palm heart extract's anti-inflammatory effect was consistent with this finding. A recent study by Abdul-Hamid *et al*. (2016) found that some grades of Ajwa date fruit methanol extracts show a strong NO inhibitory action in γ-INF and LPS-stimulated RAW264.7 cells. The results of this investigation corroborate the anti-inflammatory effect.

Table 5. Anti-inflammatory activity of palm heart by means of HRBC hemolysis and membrane stabilization in vitro.

Standard (Indomethacin) Conc. µg /ml	Hemolysis Inhibition %Standard Indomethacin	Hemolysis Inhibition %Sample
1000	98.9	93.9
800	97.3	79.1
600	95.3	61.2
400	93.5	44.2
200	90.1	27.4
100	88.0	22.0

Anticancer activity of palm heart ethanolic extract:

With 10 million deaths from it in 2020, cancer ranked as the second leading cause of mortality globally (Siegel *et al.*, 2022; Sung *et al*., 2021). Males in Thailand are more likely than females to develop lung cancer (16.5% of new cases) and prostate cancer (9.2% of new cases); breast and cervical cancers (22.8% and 9.4% of new cases, respectively) are more common in women (Sung *et al*., 2021; Kulthanachairojana *et al.*, 2021)

Breast cancer is the second most prevalent and deadly cause of cancer-related death in women is., after lung and bronchus cancer. The BRCA-1 and BRCA2 genes only predispose 10% to 15% of cases of breast cancer (Bishop, 1999). Nutritional and environmental factors that are unknown contribute to the remaining breast cancer incidence. The majority of chemotherapeutic medications now in use have side effects and harm healthy cells (Patel and Prajapati, 2011). Therefore, dietary strategies for the prevention and treatment of breast cancer would be highly beneficial in lowering the risk and death rate.

Among women, the primary cause of cancer-related mortality is cervical cancer, and the fourth most prevalent type of cancer overall according to Sung *et al.* (2021). The main cause of cervical cancer is the human papillomavirus (HPV), with cofactors including smoking, high parity, prolonged use of oral contraceptives, and sexually transmitted diseases.

The incidence and death rates of HPV have dropped as a result of preventative efforts like vaccination and screening campaigns. However, the incidence of cervical cancer is still disproportionately high in low- and middle-income nations; by 2020, these nations will account for 90% of new cases and fatalities globally (Canfell, 2019).

The ethanolic extract from the palm heart (*Phoenix dactylifera, var*., Zaghloul) was evaluated using two human cell lines: Mcf7 for breast cancer and Hela for cervical cancer. The palm heart ethanolic extract was used to treat the two cancer cell lines with varying concentrations (1000 – 31.25 µg/mL; in triplicate). The effectiveness of the palm heart ethanolic extract is demonstrated by the results shown in Table 6 and Fig. 3, which also indicate a concentration-dependent rise in cell toxicity and a decrease in viability of MCF-7 and HeLa cells.

Table 6. Effect of palm heart extract against Mcf7 and Hela cells.

Palm heart extract Concentration, µg/mL	Breast cancer cells (Mcf7)		Cervical cancer cells (Hela)	
	Viability	Toxicity	Viability	Toxicity
Control	100^{a}	0^{e}	100^{a}	0^{f}
1000	2.41^{e}±0.07	97.59^{a}±0.07	2.85^{f}±0.46	97.15^{a}±0.46
500	3.31^{e}± 1.29	96.69^{a}±1.29	6.16^{e}±0.99	93.84^{b}±0.99
250	9.00^{d}±0.40	91.00^{b}±0.40	25.06^{d}±1.09	74.94^{c}±1.09
125	14.19^{c}±2.23	85.81^{c}±2.23	47.58^{c}±1.68	52.42^{d}±1.68
62.5	48.03^{b}±2.54	51.97^{d}±2.54	89.85^{b}±2.55	10.15^{e}±2.55
31.25	99.50^{a}±2.31	0.50^{e}±2.31	99.92^{a}±1.61	0.08^{f}±1.61
IC_{50} dil.	77.06 µg/mL		122.36 µg/mL	

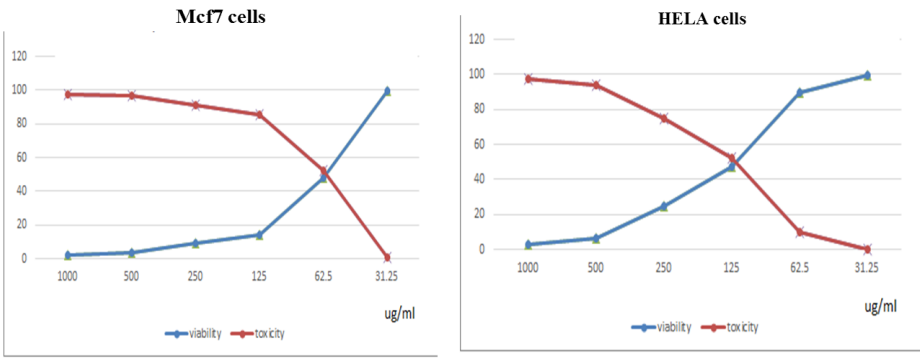

Fig 3.Effect of palm heart extract on Mcf7 and HELA cells at different concentrations.

Compared to the control, the low extract concentration of 31.25 had no discernible impact on cell viability. The viability of the two types of cells was significantly reduced at all other concentrations, and their cellular toxicity increased as a result. The viability for the palm heart ethanolic extract with concentrations of 125, 250, 500, and 1000 µg/mL against MCF-7 cells recorded 14.19, 9.00, 3.31 and 2.41%, respectively. Meanwhile, results recorded 47.58, 25.06, 6.16 and 2.85, respectively, against HeLa cells. The observation suggests that the MCF-7 and Hela cell lines are more responsive to palm heart ethanolic extract. The IC_{50} values of the palm heart extract were observed at concentrations of 77.06 µg/mL for MCF-7 cells and 122.36 µg/mL for HeLa cells, which are good results for an anticancer agent.

As seen in Figures 4 and 5, the ethanolic extract of palm heart markedly altered the cells' morphology compared to the control. The morphological alterations in the cells rose in tandem with the palm heart extract concentration. After 24 hours of incubation, a significant number of dead and detached cells suggested that the palm heart extract had a detrimental effect on the growth of tumor cells.

No significant changes were caused by the low concentration of 31.25 µg/mL. On the other hand, the high palm heart extract concentrations caused significant morphological alterations in the tumor cells and the extract concentration rose in tandem with the extract concentration.

In their investigation, Hameed *et al*. (2021) used heart extract and GCMS analysis to identify 15 bioactive compounds. Certain chemicals have been found to offer health benefits. For example, cis-vaccenic acid has been used in the treatment of inflammation, cancer, cardiovascular disease, and immunological function (Tripathy and Jump, 2013), and squalene is primarily used as an adjuvant therapy in various cancers (Jun *et al*., 2021).

Certain investigations have demonstrated the anticancer effects of *P. dactylifera.* Date palm fruit has been shown by Reem *et al*. (2020) to have chemopreventive qualities against pancreatic cancer. Ethyl acetate of Ajwa dates was found by Mirza *et al*. (2018) to suppress prostate cancer and cause apoptosis through the S phase. Ajwa date aqueous extract has been shown by Khan *et al*. (2018) to enhance liver functioning and prevent hepatocellular cancer. Aqueous ethanolic extract of parthenocarpic dates was reported by Hanen *et al*. (2018) to be cytotoxic to breast cancer cells, as evidenced by its ability to stop the growth of MCF-7 and MDA-MB-231 cells.

An ethyl acetate extract of *P. dactylifera* L. was discovered by Nael *et al*. (2018) to have strong antiproliferative effects on MCF-7 cells. According to Khan *et al*. (2016), MCF-7 cells were inhibited by the methanolic extract of Ajwa dates by the induction of apoptosis and cell cycle arrest in the S phase. The inhibiting effect of *P. dactylifera* (Hillawi variety) heart extract on MCF-7 cancer cells was investigated by Hameed *et al*. (2021). After treatment for 24 hours, the IC_{50} value was 620.1 µg/ml, indicating that heart extract effectively inhibited the proliferation of MCF-7 cells. The anticancer powers were further assessed using the IC_{50} value.

Numerous medicinal plants have been shown to have anti-cancer properties in the literature; using medicinal plants as a method for cancer therapy and prevention has been done for a long time and has shown promise (Kumar *et al*., 2011; Khazir *et al*., 2014). With the growing interest in organic and minimalist living, plant-based medicine is becoming more and more popular (Gálvez *et al*., 2003). Furthermore, the creation of artificial anti-cancer drugs is hampered by side effects and drug resistance. For these reasons, research on plants has been conducted worldwide as novel and promising sources of anti-cancer drugs. Earlier studies on *C. variegatum* have shown its anti-inflammatory and anti-cancer properties (Anim *et al*., 2016; Hassan *et al*., 2013; Pechangou *et al*., 2023). As a result, studies have concentrated on examining the potential benefits and uses of terrestrial plant extracts for the creation of potentially effective drugs for conditions like cancer (Abu-Darwish and Efferth, 2018).

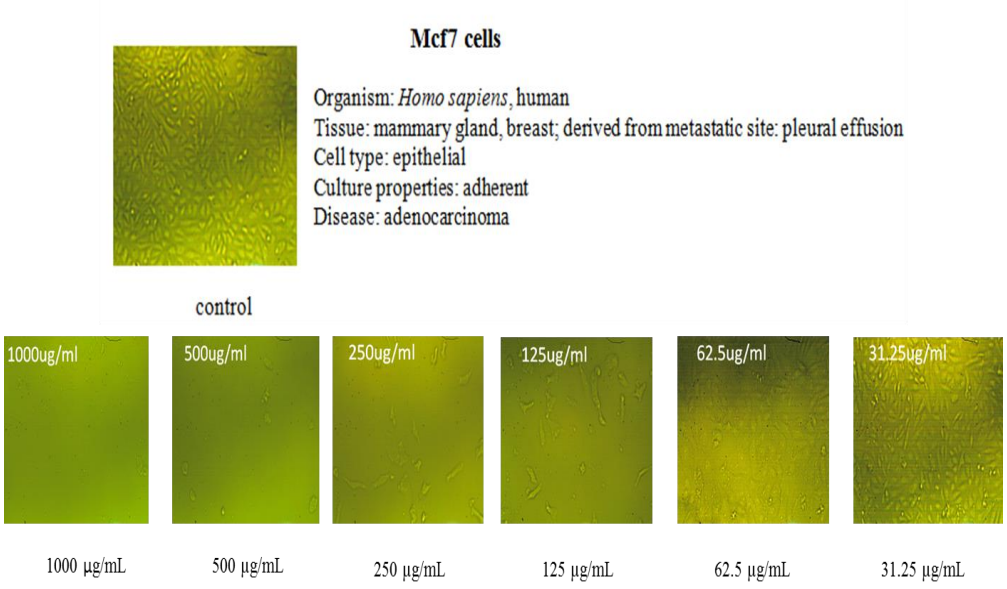

Fig. 4 . Effect of palm heart extract on Mcf7 cells at different concentrations.

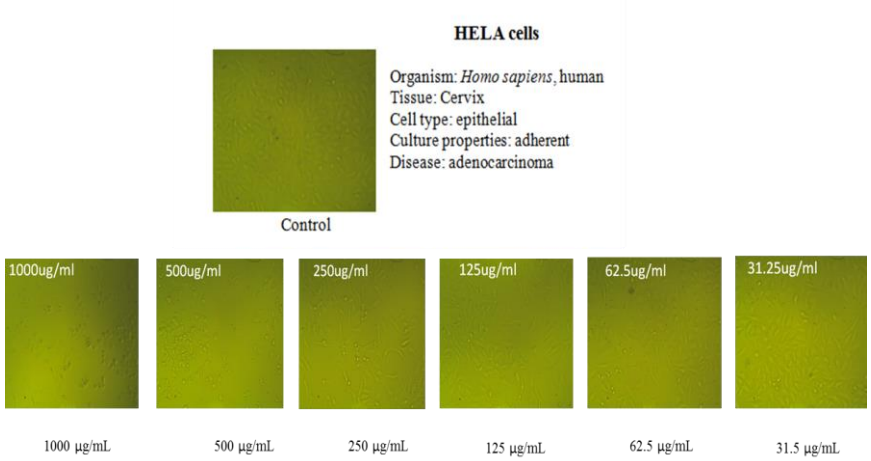

Fig. 5 .Effect of palm heart extract on HELA cells at different concentrations.

CONCLUSION

This study suggests that the palm heart (*P. dactylifera* L.) has antioxidant, anti-inflammatory, and anti-cancer properties on cervical and breast cancer cells due to its content of phenolic and flavonoid compounds. Because of this, the edible portions of the *P. dactylifera* tree are abundant in bioactive substances and ought to be a staple of our healthy nutritional systems, frequently ingested to prevent cervical and breast cancer.

Conflict of interest

The author declares that there is no conflict of interest regarding this publication.

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" تقييم النشاط المضاد للأكسدة والمضاد للالتهاب والمضاد للسرطان لقلب النخيل في المختبر"

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الملخص

استهدفت الدراسة تقييم التركيب الكيميائي لقلب نخيل البلح الزغلول والمعروفة محلياً باسم "الجمار" وتأثير مستخلصها الإيثانولي كمضاد للأكسدة ومضاد للالتهابات ومضاد للسرطان في المختبر باستخدام خلايا سرطان الثدي و خلايا سرطان عنق الرحم. أثبتت النتائج أن قلب النخيل غني بالألياف والبروتين والكربوهيدرات، ويحتوي المستخلص على 37.7 ملجم / QE جم من إجمالي الفلافونويدات و 79.6 ملجم / GAE جم من إجمالي الفينولات. تم تحديد النشاط المضاد للأكسدة للمستخلص الإيثانولي باستخدام اختبار الشقوق الحرة (DPPH). كان نشاط إزالة الشقوق الحرة هو الأقصى عند 73.19٪ و 67.68٪ على التوالي، لتركيزات المستخلص 1000 ميكروجرام / مل و 500 ميكروغرام / مل، في حين كانت قيمة IC_{50} 73.97 ميكروغرام / مل. نظرًا لأن المستخلص الإيثانولي يقلل بشكل كبير من انحلال خلايا الدم الحمراء، فقد كان له تأثير مضاد للالتهابات. عند 1000 ميكروغرام / مل، تم تحقيق أقصى نسبة تثبيط والتي كانت 93.9٪. في خطوط الخلايا البشرية لسرطان الثدي (Mcf7) وسرطان عنق الرحم(Hela) ، خفض المستخلص قابلية الخلايا للبقاء بطريقة تعتمد على التركيز. وبالمقارنة مع المجموعة الضابطة، فقد غيّر أيضًا بشكل كبير مورفولوجيا الخلايا. لذلك، يوصى بتناول قلب النخيل "جمار" إما طازجًا أو في المنتجات الغذائية للوقاية من بعض أنواع السرطان.

الكلمات الدالة: قلب النخيل، مضاد للسرطان، مضاد للالتهابات، سرطان الثدي، سرطان عنق الرحم