The Role of Oily and Methanolic Extracts of *Phoenix Dactylifera* Leaves in Ameliorating CCl₄ Cytotoxicity in Male Rats

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**ABSTRACT**

The study was performed to investigate the protective effect of different methanolic and oily extracts of leave and dry date of *Phoenix dactylifera* against oxidative stress induced by CCl₄ on 49 Sprague-Dawley male rats weighed 175-200 g and aged 6-8 months. The animals were equally divided into 7 groups and assigned as follows: G1, administered 0.1 mL distilled water orally and considered control negative group (C⁻ve); G2, administered 0.1 mL/100 g BW corn oil (CrO); and G3 administered 100 mg/kg BW CCl₄ orally for induction oxidative stress and considered control positive group (C⁺ve). The other four groups were initially administered 100 mg/kg BW CCl₄ for oxidative stress induction and treated for two months as follow: G4, treated orally by 100 mg/kg BW of date methanolic extract (DME); G5, treated orally by 150 mg/kg BW of leaves methanolic extract (LME); G6, treated orally by 150 mg/kg BW of leaves methanolic extract (LME); G6, treated by 250 mg/kg BW date oily extract (DOE); while G7, treated by 250 mg/kg BW leaves oily extract (LOE). At the end of two months experiment, the animals were scarified, and their femurs removed for cytogenetic examination. results showed that only CCl₄ group had significant increase (P<0.05) increase 5.1±0.5 compared to negative control and all treated groups. CCl₄ group also recorded clear increasing in percentage of chromosome aberrations including diverse types in bone marrow cell compared to rat groups treated by date and leaves methanolic and oily extracts and negative control groups. It could be concluded that the treatment with different palm date and leaves extracts failed to overcome the genotoxic effect of CCl₄ completely. Possibly, because CCl₄ dosed for extended period (2 months) might cause extensive cell and genetic damages could be opposed antioxidants presented in the different palm extracts recording some but lesser chromosomal aberration compared to that CCl₄ treated group.

**Keywords:** *phoenix dactylifera*, leave, dry date, oxidative stress, antioxidant, cytogenetic

**INTRODUCTION**

Most of mutagenic and carcinogen agents display their destructive effects through free radicals including reactive oxygen's species (ROS) (1). The date palm (*Phoenix dactylifera* L.) is one of oldest cultivated plants of humankind used as food for six thousand years. There are more than two hundred varieties of dates
available worldwide especially in Iraq. Date palm serves as a healthy food source as it is rich in carbohydrates and even became a part of Arabian diet. Aside from a common food source, date palm fruits have been used traditionally to treat distinct types of ailments and it has been regarded that consumption of the fruit is good for health (2). Moreover, recent studies have shown that date fruits are an excellent source of phenolics and therefore possess an extremely high antioxidant capacity. Dates have potent anthocyanins, carotenoids, and phenolics compounds (protocatechuic, p-hydroxy benzoic, vanillic, syringic, caffeic, coumaric, ferulic, hydroxy benzoic, mainly cinnamic acids) and flavonoids (flavones, flavanols and flavanones) (3). It is also scientifically proved to possess a variety of pharmacological activities which indicate its usefulness in various kinds of diseases and disorders. It possesses anticancer, antimitogenic, antihyperlipidemic, nephroprotective, and in vivo antiviral activities, and the ability to increase the concentration of testosterone, follicle stimulating hormone (FSH) and luteininzing hormone (LH). Many researchers have also documented the antioxidant property of Phoenix dactylifera (4). Therefore, this study designated to investigate the cytogenetic effects which play a key role in cancer (genetic damages and changes in DNA sequences and genes mutations and chromosomal structure) of different palm extracts against oxidative stress induced by administration CCl4 to male.

**Materials and Methods**

**Collection of Plant Materials and Extraction**

Phoenix dactylifera fresh leaves and dry fruits (Alzahdy) were obtained from Kufa cultivar, Iraq during October 2014. The leaves were washed thoroughly in running tap water, then dried for four weeks at room temperature and blended by mechanical blender, while dry date was cleaned, seeds have been removed and the edible part of date was dried at room temperature before grinding with a meat grinder to produce date paste.

**Methanolic extraction** of date paste or leaves powder sample were added to 500 ml of Methanol 70% mixed thoroughly by magnetic stirrer for 24 hours according to method (5).

**Oily extraction** for leaves by Soxhlet apparatus according to Charef, et al, (2008) (6), while dry date oily extract according to Soxhlet organic extraction method (7) using hexane and modified by adding methanol to hexane to increase the extract yield of oil by more than double.

**Experimental Design**

This study is undertaken under the approval of the scientific committee of the department of physiology, biochemistry and pharmacology, College of Veterinary Medicine, University of Baghdad. General ethical standards of the animal welfare have been considered.

This experiment was designed and performed on 49 Sprague-Dawley male rats weighed 175-200 g and aged 6-8 month; these animals were purchased from the animal house, College of Veterinary Medicine, University of Baghdad. The animals procured in the air-conditioned room under ideal environment of temperature 25±1 °C and dark/light cycle 12/12 hours and left for two weeks for acclimatization before starting the experiment. The animals were equally divided into 7 groups and assigned as, G1 administered 0.1 mL distilled water (DW) orally and considered as a control negative (C−), G2 administered 0.1 mL/100 g BW corn oil (CrO), G3 administered 100 mg/kg BW CCl4 orally for induction oxidative stress and considered as a control positive (C+++). The other four groups were initially administered 100 mg/kg BW CCls for induction oxidative stress and treated for two months as follows: G4; treated orally by 100 mg/kg BW of date methanolic extract (DME); G5, treated orally by 150 mg/kg BW of leaves methanolic extract (LME); G6, treated by 250 mg/kg BW date oily extract (DOE); while G7, treated by 250 mg/kg BW leaves oily extract (LOE).

All the dosed materials, drugs and plants extracts were administered as 0.1m/100g BW of the rat by fitting the solutions concentrations. At the end of the experiment, all animals have been scarified and their femurs were removed for cytogenetic examination.

**Cytogenetic Study**

Chemicals was used in this study included, Phosphate Buffer solution (PBS) purchased from Chemical point-Germany, has been prepared in laboratory by dissolving 9.86 g of phosphate buffer powder in one litter of distilled water and PH was adjusted to 7.2 using PH meter (Toledo-Switzerland) and used for harvesting bone marrow stem cells. Hypotonic solution of 0.075 prepared by dissolving 1.1175 g of KCl (BDH-company-England) powder in distilled water up to 200 ml for swelling of the stem cells. The chlchicine solution was prepared by dissolving colchicine tablet 1 mg (Mayolyspinder-France) in 20 ml D.W. which was used for stopping cell cycle division. Fixative solution consisted of 3 parts of absolute methanol (Scharlau-Spain) and 1 part of glacial acetic acid (BDH-company-England) and used for fixation of stem cells permanently. Giemsma stain stock solution prepared by dissolving 2 g of Giemsma stain powder (Vaccine and Sera institute-Iraq) in 100 ml absolute methanol and mixed well for 3 days by magnetic stirrer (ADAM-India), while the Giemsma working solution was prepared as 1:4 Giemsma stock solution: DW for staining the bone marrow (stem cells) smears.
Parameters

Mitotic index in bone marrow was calculated according to (8) and calculated according to the equation (MI=Number of cell at metaphase/ Total number of cells (1000) \times 100).

Chromosomal aberration was evaluated according to the method of (11), briefly by harvesting of bone marrow (stem cells) by PBS, stopping the cell cycle division by cholchicine, swelling the cells by hypotonic solution of KCL, preserving the stem cells in fixative solution, dropping the stem cells from the height 1 meter above the slide and finally staining the bone marrow smears by Giemsa stain.

The metaphases were analyzed for the numbers and types of chromosome aberrations that were classified to the chromosomal damages observed in this study which were in the form of fragmented chromosome (FC), acentric chromosome, ring chromosome (RC), elongated chromosome (EC), chromatid gaps (Ga), chromatideletions (Cd), and aneuploid. In each slide, 100 mitotic cells were counted to determine the chromosome aberrations.

RESULTS

Mitotic Index (MI)

Cytological examination revealed that CCl4 was found to be effective in increasing cell proliferation (estimated as mitotic index). The results presented in Table (1) showed that the analysis of mitotic activity after treatment with carbon tetrachloride alone showed significantly increased (P<0.05 in MI (Figure-1) compared to negative control (C -ve DW). Treatment with CCl4 + methanolic extract of date and leaves at dose 100, 150 mg/kg respectively were showed significant decrease in MI from that of the CCl4 alone and significantly (P<0.05) increase when compared to control distilled water group (C -ve DW ) (Figure 4), while the groups treated with CCl4 + oily extracts of date and leaves at dose 250 mg/kg showed significant decrease (P<0.05) compared to CCl4 group but without significant difference from methanolic date extract (Figure 3).

Table 1. Mitotic index of bone marrow cell in rats treated with date and leaves alcoholic and oily extracts with CCl4 compare with control groups

| Groups        | Mitotic Index±mean |
|---------------|--------------------|
| DME           | 1.4±0.30           |
| LME           | 1.9±0.10           |
| DOE           | 2.1±0.06           |
| LOE           | 2.3±0.10           |
| C -ve CCl4    | 5.1±0.50           |
| C -ve CrO     | 1.9±0.07           |
| C -ve DW      | 0.9±0.20           |

LSD=0.81. * Different capital letters refers to significant results between groups (P≤0.05). DME, date methanolic extract= treated orally by 100 mg/kg BW of DME; LME, leaves methanolic extract= treated orally by 150 mg/kg BW of LME; DOE, date oily extract= treated by 250 mg/kg BW DOE; LOE, leaves oily extract= treated by 250 mg/kg BW LOE; C++, control positive= administered 100 mg/kg BW CCl4 orally for induction oxidative stress; CrO, corn oil= administered 0.1 mL/100 g BW; C**, control negative= administered 0.1 mL distilled water orally
Chromosomal Aberration

Various types of structural chromosomal aberrations (Figure 5) were observed after the administration of carbon tetrachloride alone or plus date and leaves of methanolic and oily extracts compared to the negative control groups included fragmented chromosome (FC), a centric chromosome (AC), ring chromosome (RC), elongated chromosome (EC), chromatid gaps (Ga), chromatid deletions (Cd), segmental deletion (SD) and aneuploid as shown in figures (5). CCl4 group recorded clear increasing in percentage of chromosome aberrations compared to rat groups treated by date and leaves methanolic and oily extracts and negative control groups while the groups treated by date and leave oily extracts still recorded more cytogenetic changes compared to oil and distilled water control groups (Table 2).

Table 2: Percentage of some chromosomal aberrations of bone marrow cells of experimental group

| Groups n=5 | Chromosomal Lesion | Chromosomal Lesion | Chromosomal Lesion | Chromosomal Lesion | Chromosomal Lesion | Total |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------|
|            | Fragmented chromosome (%) | Chromatid deletion (%) | Ring chromosome Gap (%) | Chromatid Stick (%) | Elongated chromosome (%) | Aneuploidy (%) |
| C-ve DW    | 3                  | 0.3               | 0                  | 0                  | 0                  | 0.033 |
| C-ve CorO  | 10                 | 0.6               | 4.3               | 3                  | 0                  | 1.4   |
| C+ve       | 25                 | 15                | 8.9               | 10                 | 7                  | 12.6  |
| LME        | 17                 | 9.3               | 7.2               | 5                  | 4.8                | 2.1   |
| DOE        | 18.4               | 8.5               | 5.7               | 6.5                | 4.8                | 3.6   |
| LOE        | 19.1               | 10.9              | 5.3               | 6.8                | 5.2                | 4.4   |

C++, control negative—administered 0.1 mL distilled water orally; C-ve, corn oil—administered 0.1 mL/100 g BW; C+ve, control positive—administered 100 mg/kg BW CCl4 orally for induction oxidative stress; DME, date methanolic extract—treated orally by 100 mg/kg BW of DME; LME, leaves methanolic extract—treated orally by 150 mg/kg BW of LME; DOE, date oily extract—treated by 250 mg/kg BW DOE; LOE, leaves oily extract—treated by 250 mg/kg BW LOE.

Figure 5: The different chromosomal aberrations from bone marrow cells of rats from different experimental groups. (A) normal chromosome. (B) acentric chromosome (AC), fragmented chromosome (FC), chromatid gap (Ga). (C) chromatid deletion (CD), chromosome deletion (CD). (D) segmental deletion (SD), chromosome fragment (F), chromatid gap (Ga). (E) stickiness (St), chromosome fragment (F), chromosome gap (Ga). (F) chromosome elongation (E), chromosome fragment (F). (G) ring chromosome (R). (H) aneuploid (An)(Giemsa stain, 100×).
DISCUSSION

The results of present cytogenetic study in bone marrow cell of all subchronically treated experimental groups rat treated with CCI4 showed highly extensive genotoxic effects possibly because of high exposure for two months effects causing two types of chromosomal mutation one is clastogenesis with structural chromosomal or chromatid damages manifested by (chromosome fragment, chromatid deletion, ring chromosome, elongated chromosome, chromosome gap, stick chromosome and acentric chromosome). The second type is aneuploidy that is considered (numerical) chromosome change.

The results were obtained by many studies (12) and (13) and (14), showed that CCI4 treatment induced different types of chromosome aberration (CA) with increased of the number of dividing cells.

A possible mechanism for CCI4 induced chromosomal aberration involved in the formation of free radicals, either via auto-oxidation or by enzyme- catalyzed oxidation of organic compounds in CCL4. These free radicals could react with lipids and may lead to lipid peroxidation of cell membrane in tissues causing the breakage of the DNA chain by oxidizing the base in DNA and covalent binding between the product of lipid peroxidation and DNA. They could also react with proteins, affecting the structures and functions of enzymes, and alter the membrane properties. In addition, the free radicals could also attack nucleic acids, especially some spots in purine and pyrimidine, resulting in base substitution and breakage of DNA, and eventually inducing mutation (12). The noticed chromosomal aberration mainly in CCL4 group and to lesser extent in palm oily and methanolic extracts was: Ancentric chromosome is an aberrant chromosome that lacks a centromere. Ring chromosome forms when a portion of a chromosome is broken off and formed a circle or ring. They are basically deficiencies and therefore render the carrier liable to the usual consequences of a missing genetic material (12) or induction of ring chromosomes suggesting the possibility of two breaks that occur in the same chromosome or may result from telomeric losses. According to Hall and Garcia (14), presence of ring chromosomes is a condition which is highly lethal to the cell.

Stickiness of chromosomes is one of the major abnormalities noted in the present study. It could be observed different degrees of stickiness in all the treatments. Stickiness might be caused by the physical adhesion of chromosomal proteins or due to the disturbances in the nucleic acid metabolism of the cell or the dissolution of protein covering of DNA in chromosomes (15).

Aneuploid cells noted in the treatments might be due to the occurrence of multipolar mitosis or lagging chromosomes producing two aneuploid daughter cells.

Chromosome fragments are signs of extreme lethal clastogenic effects resulting from chromosome and chromatid breaks. Fragments may arise due to stretching of chromosomes at metaphase followed by breakage at these fragile sites (12).

While all palm extracts (alcoholic and oil) recorded less but still present some genotoxic effect compared to CCI4 and control groups. These results are in agreement with those obtained by Gabal et al. (2007) who recorded an increase in the frequency of chromosomal aberrations in both bone marrow cells of male mice treated with CCl4 (16).

Alghamdy et al. (2013) studied the protective effect of date extract against genotoxic effect performed by bone marrow cell, and recorded analysis of chromosomal aberrations in the efficacy of date extracts in reducing the frequency of different types of chromosomal aberrations induced in bone marrow cells in particular aneuploidy and ring chromosome (17). This finding suggested that date extract has antimutagenic effect and protects the cells from the mutagens which it contains highly quantity of protein and fat such as oleic, linoleic, palmitic, myristic and steaic acid when compared to date flesh. It is also high in dietary fibers, phenolics and antioxidants. It is assuming that cumulatively the presence of all these components in the date may have responsible for reduction of DNA binding and methylation with CCI4 (18). The current findings on DNA damage are in agreement with Aboul-Enein, et al. (2014) who found that administrations of CCI4 to rats caused significant increase of DNA damage as compared to normal control.

The current cytogenetic results showed extensive genotoxic effect in CCI4 group with fewer effects recorded in bone marrows of date and leaves extracts treated groups. All of these types indicated that the genotoxic effect of CCI4 was so extensive that possibly causing nonsense mutation with complete loss of proper genetic function that may give rise to disturbance in their cell cycles division promoting for enhancement of cell division with higher opportunity of development of cancer. The increase in mitotic index of CCI4 treated group was only indicative of such conclusion. This sort genotoxic effect was mostly seen in progressive stage of cancer with karyotypic instability leading to development of cancer or genetic disorder (18). On the other hand, palm extract of fruits and leaves caused significant reduction in the mitotic index as well as less extensive genotoxic effect as indicative of partial protection against CCI4 cytogenetic effect.

Treatment with different palm date and leaves extracts did not succeed to overcome completely the genotoxic effect of CCI4. Possibly, because CCI4 dose for long period (2 month) might cause extensive cell and genetic damages that cannot be opposed antioxidants presented in the different palm extracts recording some, but lesser chromosomal aberration compared with that CCI4 treated group.
تأثير الحماية الخلوية الجينية للمستخلصات الدهنية والكحولية للتمر النباتي

الدكتور محمد جبر الركابي
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ACKNOWLEDGEMENTS

The authors are appreciated the faculty members of the College of Veterinary Medicine, University of Baghdad for providing all facilities for completing this work.

FUNDING

These authors declare that above-submitted work was not funded by any governmental or private funding source nor supported by any financial projects.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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