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Health benefits, male fertility, nutritional aspects of dates and date palm pollens: An overview

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Abstract

Date or date palm is botanically called *Phoenix dactylifera* and belongs to flowering plant species in the palm family. Date palm (*Phoenix dactylifera* L.) is a rich source of vitamins, minerals, phenolic acids, carotenoids, and flavonoids. These act as antioxidants and protect the body from free radical damage and improve fertility levels in males. Date palm pollen is rich in steroidal compounds like estriol, estrone, triterpene, and estradiol and all these are structural precursors such as immature gonadotropic and a-amyrin structures. This review aims to provide in-depth perceptiveness regarding the nutritional and phytochemical composition of date palm pollen and dates and reveal their impact on health. In this review, to sum up, the impact of date palm pollen and dates on different fertility parameters (sperm count, motility, morphology, overall semen volume as well as sex hormones level) and how it can correct infertility or improve infertility level. Date palm pollen, along with dates, has anticancer, antidiabetic, anti-inflammatory, nephron-protective, neuroprotective, antimicrobial, and antioxidant potential.

Keywords: Date palm pollen, Dates, Diseases, Male fertility, Phytochemical

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Introduction

Dates and date palm pollens are of supreme importance among diet because of their high nutritional value but the knowledge about their benefits is less known by the people. Among the cash crops dates also have a valuable place. *Phoenix dactylifera L* is the scientific name of Date palm and it belongs the Palm family (Arecaceae). About 200 genera are of this family and as far as it comes to species 2500 are related to this family (Johnson et al., 2011). It is mostly cultivated in hot regions Arabian Peninsula, Asia, Africa, and the Middle East (Nasir et al., 2015). Date palm pollen is produced by male date palm trees when reaching maturity by flowers and they pollinate with a female palm tree to produce dates. Date palms have male and female gender trees separately. 500 g of pollen are produced by a good date palm pollinator. Male flowers are creamy-white and their odor is like dough of bread (El Hadrami & Al-Khayri, 2012).

There are three parts of the fruit of date one is pit, the skin of date, and flesh of date. Classification of dates can be done on the ground of invertase and content of sugar presence: a) category in which no invertase present-dry dates, 57% of sucrose and 17% of reducing sugar, b) invertase in excess is present-soft dates, 77% of reducing sugar, c) invertase in small quantity present-semi soft dates, reducing sugar is about 39% and sucrose is 38% (Kacem-Chaouche et al., 2012). Correspondingly, dates are categorized into 4 types based on their ripening Kimri, Tamar, Rutab, and Khalal. Sugar content and size of fruit increase and a high amount of moisture is present during the Kimri stage. On the other hand, moisture content becomes low about 20%, and the date is dry now and TSS is about 70% in the Tamar stage (Al-Alawi et al., 2017). In Pakistan, 537204 metric tons of Dates are produced yearly (FAO, 2014).

Nutritional composition of Date palm pollen and dates

Nutrients

Carbohydrates, dietary fiber, and a very low quantity of protein and lipids are present (Ghnimi et al., 2017). Different kinds of phytochemicals are also present that give the dates and date palm pollen efficacy as hepato-protective, antioxidant, anticancer, anti-inflammatory, immune-stimulatory, anti-mutagenic, antimicrobial, and Fertility enhancers (Elberry, 2011; Khalid, 2017).

Date palm pollen is the main part of the date palm tree which is important in pollination and the amount of moisture

present in it is 28.80 g/100 g (Hassan, 2011). Fresh dates contain 42.4g/100g moisture. However, dried dates have 15.2g/100g moisture. Moisture in dates is usually reduced due to sun drying. Moisture reduces from Kimri to Tamar stage (Nasir et al., 2015). The carbohydrates content of date palm pollen is 26.25±0.315 g/ 100 g (Al-Samarai et al., 2020). In the case of carbohydrates, there are different amounts of carbohydrates in both fresh and dry dates. Carbohydrates amount in fresh dates is 54.9 g/100 g. But on the other side, dry dates have high carbohydrates amount that is 80.6g/100 g. There are ten varieties of dates that contain the highest sugar quantity (Mabroom, Lobanah, Burni, Safawy, Suqaey, Ajwa, Anabarah, Kodari, Shalaby, and Sukkari). Among these dates' varieties, the highest sugar is present in Burni about 81.4% and the Lobanah type has the least amount of sugar 71.2% (Assirey, 2015). Glucose content is highest in Ajwa dates (Khalid et al., 2016). The Crude Protein content of DPP as mentioned in Table 1 is 19.45 g/100 g and fat is 7.678% per 100 g, while the ash content of date palm pollen is 5.585 ± 0.144%/100g (Al-Samarai et al., 2020). Protein and fat are present in small amounts in dates. The fresh dates protein content is equal to 1.0 g/ 100 g while dried dates protein content is higher than fresh dates because of moisture loss and is about 2.14 g/ 100 g. The fat percentage of dates is 0.38g/ 100 g in dried dates and 0.14g/ 100 g in fresh dates. Ash is round about 1.67g/100g (Al-Harrasi et al., 2014). Total dietary fiber % (dry weight) is 68 ± 2, Insoluble fiber 64 ± 1, and Soluble fiber 4.1 ± 0.3 per 100 g are observed in date palm flower (Karra et al., 2019). The crude fiber in date palm pollen is 1.37g/100g of pollen (Hassan, 2011). Dates also have a very high amount of fiber as compared to cereal products. Fiber-rich products can be produced from dates (Mrabet et al., 2017). 4.7–7g/100 g of dietary fiber is present in Tunisian date types. According to Lee et al. (2016) beta-glucan is one of the components of dates that provide a wide range of health benefits like cholesterol-lowering, Gestro-protective Anti-diabetic, etc. (Table 1).

Amino acids present in DPP and dates

Amino acids are the building block of Proteins. Amino acids are of two types one is essential amino acids and the other is non-essential amino acids. DPP and also the dates are subjected to analysis to find the amino acids composition. In Table 2 essential amino acids Isoleucine (Ile), Leucine (Leu), Lysine (Lys), Phenylalanine (Phe), Threonine (Thr), Valine (Val), Histidine (His), Methionine (Met), and non-essential amino acids Alanine (Ala), Arginine (Arg), Aspartic acid, Glutamic acid (Glu), Proline (Pro), Glycine (Gly), Serine (Ser), Cysteine (Cys), Tyrosine (Tyr) their presence in the DPP and dates are expressed in term of mg or gram per 100 g or grams of pollen.

Vitamins and minerals concentration in DPP and dates

Vitamins are the micronutrients that are required in a small amount. Vitamins perform a vital function in humans. Riboflavin, Niacin, Pyridoxine, and Folic acid are found in small amounts on dry dates. 9% RDA of these vitamins is gained through 100g of dry dates consumption. 7% RDA of Vitamin B1, A, and C are obtained through 100 g of date palm intake (Parvin et al., 2015). Vitamin A (23.85 µg), Thiamine (78.61 µg), Riboflavin (116.5 µg), Niacin (1442 µg), Pyridoxine (207 µg), Folic acid (53.75 µg) and Ascorbic acid (C) (3900 µg) (Nasir et al., 2015). As a co-enzyme Vitamins work in our body. Ascorbic acid acts as an antioxidant and protects from free radical damage. Water soluble vitamins are helpful in the analysis of date palm vitamins. Vitamin Thiamine (B1), Riboflavin (B2), and Cyanocobalamin (B12) are present in the amounts 13ug/g, 260ug/g, and 2316ug/g respectively in one variety of Egyptian Hiani date palm pollen (Bishr & Desoukey 2012). Fat-soluble vitamin in date palm pollen vitamin A 7708.33 IU/100g and Vitamin E 3030.92 IU/100g and water-soluble vitamin C 89.09mg/100g are present (Hassan, 2011).

Minerals are needed in small quantities by our body and are very crucial for normal body functions. Sodium is present in dates in a limited amount. Average sodium is about 8.5 to 69.3 mg/100 g. Dates contain a high amount of Potassium. The potassium content of dates differs among kinds of dates from 524 to 1164 mg/100 g. 100 g of dates give 50% of the RDA of Potassium. Calcium is required for strong bones and teeth. 81.40 to 195.18 mg/100g calcium is present in various kinds (Nadeem et al., 2019). For optimal functioning of 200 enzymes, brain, and nerves magnesium is required. Magnesium content varies from 31.9 to 62.3 mg/100 g dates varieties. 1.76 mg/100 g Iron is present in dates. 0.25 to 60.0 mg/100 g Zinc is found in the date's varieties. Manganese is about 0.35 to 0.47 mg/100 g in dates. About 0.14 to 1.60 mg/100 g of copper is present in dates. Copper deficiency in fetal development in the mother body can disturb the cardiovascular system, bone formation as well as brain development (Bost et al., 2016). In Table 4 mineral composition of date palm pollen in mg per 100g of date palm pollen, based on percentage in date palm pollen as well as dates presence is discussed.

Phytochemical composition

Phytochemicals are compounds that are nonnutritive and are plants secondary metabolites. Phytochemicals protect humans from several chronic ailments like CVD, Cancer, Diabetes, etc. With several nutritive components dates also contain phytochemicals in their composition (Vayalil 2012). Bioactive compounds are found in various fruits. Similarly, dates and date palm pollen are also rich in Phenolic acid, Carotenoids, Flavonoids and Polyphenols (Al Juhaimi et al., 2018).

Carotenoids

Dates in their lipid fraction have carotenoid as a phytochemical., Tetraterpenoids is the name that is also given to Carotenoid and they possess vital health benefits for mankind. Several studies confirm their presence in dates in a greater quantity (Vayalil, 2012). According to a study which is conducted in the UAE of several dates' varieties, Beta- carotene (1.18–2.68mg/100g) is the main type of carotenoid that is found in date varieties oil. About 1.46 and 3.53mg/100g is the carotenoid content in total that is present (Habib et al., 2013). Amounts of carotenoids present in the dates is affected by the ripening stage of dates, carotenoid concentration decreases from fresh to dry dates. In date varieties Deglet Nour 81g/100 g of carotenoid and 112g/100 g of carotenoid in Medjhool are present (USDA, 2012). Date palm pollen are rich in carotenoids.

Tocopherol

Another important phytochemical that is found in the lipid fraction of date palm pollen and dates is tocopherol and also tocotrienol. This class belongs to the fat-soluble Vitamin E group and antioxidant activity is the property of this vitamin. α-tocotrienol (34.01mg/100g) and ϒ-tocotrienol (4.63mg/100g) are found in these amounts in Tunisian dates. Similarly, ϒ-tocopherol (10.30mg/100g) is present (Nehdi et al., 2010). In the oil of dates, α-tocopherol acetate has greater light and oxygen stability as compared to tocopherol which is Vitamin E another kind (Al Juhaimi et al., 2018).

Phytosterols

Phytosterols are lipid soluble phytochemicals having their structure similar to cholesterol. In fruits and vegetables, about 200 kinds of Phytosterols are present. Majorly these are present in dates flesh and pollen of dates rather than pits (Vayalit, 2014). To cure various hormonal disorders for centuries Phytosterols are being used. Estrogen ergosterol, brassica sterol, estrone are the main Phytosterol that is found in dates. ?-sitosterol (76%) is the major Phytosterol in the dates oil (Maqsood et al., 2020). Date palm pollen also contains estriol, estrone as well as estradiol found through High-Performance liquid chromatography. (Abbas and Ateya, 2011). Cholesterol and estrone are also reported in date palm pollen (Tahvilzadeh et al., 2016).

Phenolic acids

According to recent studies phenolic acids are the main component that is found in dates. In the kind of dates Khalas in UAE these Phenolic acids are present coumaric acid, protocatechuic acid, and caffeic acid (Habib et al., 2014). Nine types of phenolic acids have been reported to date. Among this cinnamic acid, derivatives are five (o-coumaric acid, ferulic acid, p-coumaric acid, caffeic acid, m-coumaric). Out of the 4 are hydroxylated derivatives of vanillic acid and benzoic acid. One thing that should be in account is that type of solvent to be used in extraction affect the Phenolic acid amount in dates or other fruit (Maqsood et al., 2020). 3-o-caffeoylshikimic acid, gallic acid, syringic acid, 3-caffeoylquinic acid, protocatechuic acid, vanillic acid, p-hydroxybenzoic acid are the polyphenols that are present in dates. Flavanols, hydroxybenzoate, hydroxycinnamates are some of the soluble phenolic compounds that have been reported in dates (Hammouda et al., 2013). Caffeic acid (0.57–1.84 mg/100 g), rutin (0.65–0.85 mg/100 g) and catechin (0.73 mg/100 g) are the ripe Ajwa phenolic content (Ahmed et al., 2016). The phenolic content of dates varies with the age of fruit or from fresh to dry dates. At the dates, the Kimri stage content of Polyphenol is (290mg/100g). At Khalal stage (150 mg/100 g) which is backed by Rutab stage (20mg/ 100g) followed by the Tamar stage of dates (10 mg/100 g) (Eid et al., 2013). A study was carried out to find the phenolic content of palm pollen which is 220 ppm (Basuny et al., 2013).

Flavonoids

Activities like antioxidants or free radicle scavenging are the attributes flavonoids that help in the prevention of CVD and other chronic ailments. In a study of Moroccan dates flavonoids content in higher amounts is reported (1224 and 1844mg Rutin equivalent/100g) of dry weight (Alem et al., 2017). Another study carried out found that flavan-3-ols as the predominant form of Polyphenols such as epicatechin is (46.8g/kg) and (3.38g/kg) of catechin is present (Habib et al., 2014). Date seed is considered the richest source of polyphenol than date fruit, grapes, tea, flaxseed, and nuts (Liang et al., 2012; Vayalil, 2012). Pollen of Date palm is also investigated regarding Flavonoids content pollen contain naringin, isorhamnetin, luteolin, rutin and apigenin found through a fraction of ethyl acetate, quercetin which was found in Date Palm Pollen extract of ethanol (Abbas & Ateya, 2011). The total flavonoids content of palm pollen is 61.30 ppm (Basuny et al., 2013). In the Table 3 phenolic acid and flavonoids content of date, palm pollen with different extract, and the phytochemical composition of dates are expressed.

Date palm and male infertility

Infertility is the condition in which a couple does not conceive or fail in establishing a pregnancy after 12 months without protection sexual intercourse (Zegers-Hochschild et al., 2017). About more than 186 million people face infertility and most people are from developing countries (Inhorn & Patrizio et al., 2015). Between 8 to 12% of couples suffer from infertility worldwide. In Pakistan, fertility levels are decreasing continuously from 2007 till now. One in six couples in Pakistan is facing this issue (Mughal et al., 2017). DNA in sperms can be directly faced damages by the free radicle through targeting bases present in the DNA (Purines, Pyrimidines). Spermatic DNA can be damaged by different methods like rearrangements of chromosomes, attacking a

single strand or double strand of DNA, or cross-linking (Wagner et al., 2018). Motility of sperms is also reduced and this is due to lipid peroxidation of the membrane of sperm through lowering the flexibility. Direct Proportionality is present between Lipid peroxidation amount and lowered motility of sperm (Morielli & Flaherty, 2015). Mitochondrial DNA damage of sperm lowered the production of energy (ATP), thereby lowering spermatic motility. So, to maintain sperm viability and health there must be a balance between antioxidants and ROS (Fig. 1).

In the context of male infertility, reactive oxygen species have a major contributing role. Due to oxidative stress sperm loses its viability. Hydrogen peroxide that produces due to oxidation exerts a toxic effect on the metabolism of the sperm and its motility. According to the reports of current studies, reactive oxygen species (ROS) contributes to 30-80% of infertility cases in men (Bisht et al., 2017). Smoking and Alcohol also did a great role in contributing to infertility and the basic mechanism that lies behind this is also oxidative stress. Both factors lower the sperm count their viability and lower the level of male hormones (Bisht et al., 2017). Locally inflammation is provoked by smoking and increment of seminal leukocytes as well as level of Seminal ROS 48% and 107% respectively seen (Agarwal et al., 2014). Like-wise a person with a history of malignancy and who has faced chemotherapy has a greater possibility of damage by free radicles (Fig. 2). So, in the context, because date palm is rich in antioxidants in terms of Polyphenols, Flavonoids, Phenolic acids, and phytosterols (Martín-Sánchez et al., 2014). Date palm pollen is the powder that is made from the flowers of the male date palm. Carbohydrates, proteins, organic acid, nucleic acid, free amino acids, lipids, and above 100 different types of enzymes, as well as cofactors, are present in the Date palm pollen (Hassan, 2011). Date palm pollen is also rich in flavonoids as well as carotenoids and is a valuable source of Vitamin A, B, C, D, E, and both hormones and different minerals (Daoud et al., 2019). Date palm pollen is rich in steroidal compounds like estriol, estrone, triterpene, and estradiol and all these are structural precursors such as immature gonadotropic and a-amyrin structure (Abbas & Ateya, 2011).

According to the study counts of sperm and their motility increased when DPP was given in the dose 120 and 240 mg/kg to rats but in the case of humans, 500mg/kg was given to humans (Mehraban, 2014; El-Neweshy, 2013). Such positive effects on spermatogenesis are demonstrated by the invigoration of systems like the endocrine and also the antioxidant. Likewise increase in the level of sex hormones like testosterone, FSH, LH as well as estradiol are increased in experimental subjects by giving DPP to them (Arfat, 2014; El-Kashlan, 2015). In one research healthy male rats are subjected to date palm pollen at the concentration 35, 70, 105, 140, 350 mg/kg intraperitoneally. Mounting in the intromission, ejaculation, and frequencies and latencies in all doses seen as well as the attraction of males towards females are seen (Abedi et al., 2012). Some studies also report that the weight of testis and epididymis also increased through date pit powder intake (Saeed et al., 2015). Impact of date palm pollen and date on fertility rate has been shown in Table 4.

Pharmaceutical properties

There are different pharmaceutical properties of dates and date palm pollen that are shown in Table 5.

Antimicrobial activity

Date palm acts as an antimicrobial agent and provides the best solution for bacterial strains that are resistant to antibodies. It is a cost-effective way to kill bacteria. Gram-Positive, as well as Gram-Negative bacteria, are inhibited by the extract of Ajwa dates (Hussain et al., 2019). *Enterococcus faecalis, Bacillus subtilis, Pseudomonas aeruginosa and Salmonella typhi* are examples of bacteria that are specifically undergoing inhibition through an extract of dates (Aamir et al., 2013). Similarly, *E. coli, Serratia marcescens, Bacillus cereus, Shigella spp* and *Staphylococcus aureus* face this inhibition through dates (Samad et al., 2016). Date palm pollen two varieties antimicrobial activities tested against 17 species and their maximum inhibition and minimum inhibition zone are found out (Daoud et al., 2019). *Fusarium oxysporum* is a fungus against date extract that acts as an antifungal agent. Antibacterial and antifungal qualities are given to an edible portion of date fruit and Antiviral activity is property of the pit of the date. But further research is needed to prove anti-viral activity. Against Food poisoning causing bacteria such as *Salmonella* and *Shigella* antimicrobial activity of dates was also reported (Garba and Galadima 2012). El Sohaimy et al., (2015) said that dates possess a phytotoxic sense towards 5 strains of bacteria. Methanolic extract of DPP Tested against the six species of bacteria Strong antibacterial activity against Staphylococcus Epidermidis equal to 22 mm as of antibiotic is noted (Abed El-Azim MHM et al., 2015).

Anticancer activity

Presently techniques that are used to cure cancer radiation therapy and chemo, possess various side effects to patients. Many types of research are undergoing to find safe treatments option to cure patients without side effects. Many functional constituents such as polyphenols, flavanols, and phenolic acids are found in date fruits as well as other fruits effective for the prevention of cancer (Al-Alawi et al., 2017). In Lung, prostate, breast, gastric, and colon tumor lines through an extract of Ajwa dates their proliferation can be inhibited (Zhang et al., 2017). Date palm improves the function of the colon through good bacteria growth increment in the colon thereby lessening the risk of colon cancer (Eid et al., 2014). β-d glucan found in date palm pollen and fruit exhibit anti-proliferative activity against MCF7, Colo-205, and T47D cancer cells (Shah et al., 2015). In one study silver date palm pollen nanocomposite was used to check the growth of the MCF-7 cell line and growth inhibition of this cell line is reported (Homayouni-Tabrizi et

al., 2018). Chlorogenic acid and Ferulic acid found in date palm pollen have strong anti-tumor activity and promote hepatic function (Kadry et al., 2019). To gain a combined effect towards a breast carcinoma Ajwa date in combination with regular chemotherapeutics can be used (Khan et al., 2016).

Neuroprotective activity

The brain is a very vital organ of our body and controls all functions of our body. Towards Bilateral common carotid artery occlusion induced cerebral ischemia dates to provide protection (Pujari et al., 2011). Constipation risk is reduced by increasing GIT transit time through consumption of aqueous extract of date (Souli et al., 2018). As date palms contain a high amount of potassium and little amount of sodium that did a great role to keep a nervous system in normal condition. Potassium that is high in date palm lowers the cholesterol. So, in this way risk of stroke can be minimized. Date palm pollen increases the level of dopamine which is a neurotransmitter that has a role in the feeling of pleasure (Abedi et al., 2014).

Anti-diabetic activity

In the management of diabetes extract of plants plays a significant role in increasing the production of insulin and decreasing the absorption of glucose in the intestine. Different active components are found in dates and all are possessing anti-diabetic activity (e.g., flavonoids, steroids, phenolics, and saponins) (Hussain et al., 2019). Either these active components extract from dates or another food material they possess antidiabetic activity because of their ability to scavenge free radicles as proved through many rat studies (Hasan & Mohieldein, 2016). Similarly, extract of dates lowered the aggravation of diabetes. The effect of dates is mainly due to the presence of phenolic compounds that stop the α-glucosidase. So, absorption of glucose in the kidney and small intestine is influenced (Zhang et al., 2017). Homeostasis of glucose is maintained and through the promotion of excretion of insulin and increasing glycogen synthase hormone by diosmetin glycosides which are derived from dates (Singh et al., 2012). By using flesh dates in different food items for sugar replacement can give health benefits to diabetic patients.

Antioxidant potential

Polyphenols, tannins, carotenoids (flavonoids, lignin's, and isoflavons), and sterols are the components of dates that have functional properties and act as antioxidants (Martín-Sánchez et al., 2014). Among dates, carotenoids are one of the main phytochemicals and are present in the date's lipid part. Vitamin A precursors are the carotenoids and they protect the cells from free radicle damage (Julia et al., 2015). Lutein, as well as β-carotene are the predominant carotenoids that are present in dates. Phyto-sterols are another class of phytochemicals that are in the lipid fraction of dates. Phytoestrogen possesses an antiestrogenic effect on the receptor of estrogen. Daidzein, secoisolariciresinol, genistein, lariciresinol, glycitein, pinoresinol, and coumestrol as well as matairesinol are the important phytoestrogen that is part of dates. Similarly, Phenolic acids are a major polyphenolic component of dates than other fruits because of their growth in high temperatures. Phenolic acids act as strong antioxidants (El Sohaimy et al., 2015). 3-o-caffeoylshikimic acid, gallic acid, syringic acid, 3-caffeoylquinic acid, protocatechuic acid, vanillic acid, p-hydroxybenzoic acid are the polyphenols that are present in dates. Phenolic acids have been reported in dates. Among these cinnamic acids, derivatives are five (o-coumaric acid, ferulic acid, p-coumaric acid, caffeic acid, m-coumaric). Date palm pollen has a strong antioxidant character due to high phenolic acid, Flavonoids, and Phytosterols (Daoud et al., 2019).

Flavonoids exhibit antioxidant activity and anti-inflammatory characteristics. In date fruits about flavonoids, 19 isomeric forms are reported. About thirteen flavonoid glycosides (such as luteolin, apigenin, and quercetin) are found in dates (Moss & Ramji 2016). Dates with nutrition benefit it is also a great source of antioxidant. It provides various health benefits and prevents man chronic diseases (Khalid et al., 2017). Most of the studies carried out in Iran, Algeria, the USA, Bahrain, and Oman confirmed the antioxidant potential of date palm.

Anti-inflammatory activities

Various health products that are produced from dates possess anti-inflammatory activities (Rahmani et al., 2014). Inflammation is usually caused by body defense response to a dangerous stimulus. Researchers separately perform researches on the anti-inflammation character of dates and the effect of dates on inflammation-associated ailments (Yasin et al., 2015). Anti-inflammatory properties are given towards flavonoids and Phenolic content of the date palm pollen and dates. Cyclooxygenase enzymes promote inflammation, lipid peroxidation of COX1 and COX2 is reported to be inhibited through the extracts of Aiwa dates with methanolic extract as well as ethyl acetate (Ahmad et al., 2016). In one study of rat's data, the palm pollen extract effect is evaluated in reducing inflammation and proliferation and the results were positive (Elberry et al., 2011). The immune response of cells is also prompted by taking a hot extract of dates (Karasawa et al., 2011). Similarly, COX2 expression is reduced or inhibited by dates and is mainly due to Polyphenols in dates. Dates are very useful and traditionally these are used in the treatment of digestive problems, various inflammatory ailments, asthma, and edema (Taleb et al., 2016). In sore throat and the mucous membrane, cure dates are very useful (Souli et al., 2018). COX-1 enzyme activity reduced 26–36% by aqueous extract of dates 100 μg/mL and 33–41% reduction through a methanolic extract of dates 100 μg/mL. About 45–48 and 48–52% reduction is reported in COX-2 through aqueous as well as methanolic extract dates 100 μg/mL respectively (Bouhlali et al., 2017).

Nephro-protective potential

Kidneys are one of the detoxifying organs. Nephrotoxicity is the dilemma of the kidney that happens by exposure of kidneys to different toxic compounds and drugs. On Wister rats' study was carried out by inducing nephrotoxicity in them and the effect of dates extract was seen on lowering toxicity. For about two months' study was carried out an increase in the level of Malondialdehyde (MDA) and a decrease in the level of glutathione (GSH) are observed. Antioxidant capacity also varies and an increase in renal profile such as serum level of creatinine, uric acid, and urea was seen.in comparison to the control group. By applying data extract lowering in the urea, uric acid, and creatinine as well as in MDA also observed. The activity of antioxidant enzymes and GSH levels also normalized (El-Arem et al., 2014). Another research of rat's hepatorenal toxicity date palm pollen administrated and the results confirmed the property of nephroprotection (Al-Asmari et al., 2020). Urea and creatinine level and Histology of kidney restored after the toxicity of lead acetate by date palm pollen in a dose of 150mg/kg/body weight (Hammed, 2015). To conclude this discussion, we can say that rats damage kidneys restore through the antioxidant capability of extract of dates and date palm pollen.

Summary about future prospective

Date palm pollens are found to be very effective in improving the fertility level in men through increasing sperm count, motility, sperm morphology, semen volume, and the level of androgens as proved by various researches. The presence of the high amount of free radicle scavengers did a great role in spermatogenesis and maintaining sperm integrity but this effect of date palm pollen is attributed to the presence of immature gonadotropins or the presence of steroidal components which is a plus point of date palm because this kind of steroidal composition is not seen in any other food. Antioxidants present in various foods and their role in improving fertility are reported. These gonadotropins improve the level of estrogen and testosterone in the body thereby increasing sperm production in the seminiferous tubules and semen quality. However extensive research is needed to carry out for date palm pollen effect on humans for providing natural and cost-effective treatment to improve fertility. Because of the human effect of date palm pollen, we found very a smaller number of studies as compared to the animal models. Moreover, need to define the recommended intake level of date palm pollen and upper toxic level. In the future researchers should investigate the mechanism of action of date palm pollen and dates health benefits that how they act in improving particular health parameters, on which cell line the act and how to prevent and treat disease. The nutraceutical industry should promote the availability and access to date palm pollen as a fertility enhancer and other benefits but first of all safe dose of date palm pollen and human studies need to be carried on a good level.

Conclusion

Dates as a whole fruit or date palm pollen possess several health benefits for mankind. Dates and date palm pollen are very rich in their Nutri-phytochemical composition. This review provides unique insight into the health benefits of date palm pollen and dates, their properties such as anticancer, antidiabetic, nephroprotective, neuroprotective, anti-inflammatory, antioxidant, and antimicrobial. In antimicrobial properties, there is a need to test the potential of date palm against viruses. The neuroprotective activity of the date palm also needs to be further investigated. This solution to improve fertility levels in men is of greater importance as compared to synthetic supplements and medicine with their possible side effects. Furthermore, date palm pollen's effect on the fertility level of human females should be carried out because date palm pollen contains estradiol and estrone that are types of the female hormone estrogen. So, this research provides a strong base on the female study.

Table 1 Composition of date palm pollen and dates

Authors	Nutrients in date palm pollen (g/100g)					
	Moisture	Fat	Protein	Carbohydrate	Fiber	Ash
Al-Samarai et al., 2018	8.041	7.678	19.45	26.25	0.113	5.585
Hassan et al., 2011	28.48	20.74	31.11	----	1.37	4.57
	Nutrients in dates (g/100g)					
Al-Harrasi et al., 2014	17.001	0.912	3.139	77.594	2.307	1.273

Table 2 Essential and non-essential amino acids present in Date palm pollen and dates

Essential amino acids	Date Pam Pollen (g/100g) Hassan et al., 2011	Date Pam Pollen (mg/gm) Bishr & Desoukey, 2012	Dates (mg/100g) Assirey et ai., 2015
Isoleucine (Ile)	1.49	17.98	44
Leucine (Leu)	3.34	26.36	57
Lysine (Lys)	2.95	26.35	73
Phenylalanine (Phe)	1.63	13.5	45
Threonine (Thr)	1.72	5.62	53
Valine (Val)	1.81	21.31	65
Histidine (His)	1.61	11.40	26
Methionine (Met)	0.11	4.40	27
Non-essential amino acids			
Alanine (Ala)	2.61	83.64	82
Arginine (Arg)	1.61	13.83	93
Aspartic acid	3.55	----	186
Glutamic acid (Glu)	1.74	----	205
Proline (Pro)	0.28	15.33	86
Glycine (Gly)	2.24	84.58	83
Serine (Ser)	1.89	----	59
Cysteine (Cys)	0.42	----	----
Tyrosine (Tyr)	1.55	0.147	----
Ammonia	0.45	----	----

Table 3 Phenolic acids and Flavonoids composition of Date palm pollen and Date fruit.

Compounds	Date Palm pollen Daoud et al., 2019	Date palm pollen Daoud et al., 2019	Dates mg/100g Hamad et al., 2015	Dates mg GAE/100 g FW Souli et al., 2018	Dates mg/100g Benmeddour et al., 2013
Caffeic acid	10.36	----	0.026	0.06	0.03
Gallic acid	27.43	05.16	15.227	0.07	7.54
Vanillic acid	05.91	05.08	----	----	----
Coumarin	12.25	55.76	----	----	----
Ferulic acid	----	----	2.56	----	2.81
Chlorogenic acid	----	----	0.20	0.03	----
Syringic acid	----	----	0.82	3.80	----
Total phenolic acids	55.95	66.10	20.37	106.60	10.86
Apigenin	----	----	0.291	----	----
Epicatechin	39.29	29.95	----	0.23	----
Catechin	04.76	04.04	0.574	0.07	----
Quercitrin	00.17	00.11	1.219	----	1.21
Rutin	00.03	00.06	0.943	----	1.08
Total flavonoids	44.25	34.16	2.821	----	3.96

Table 4 Impact of Date Palm Pollen and Dates on Fertility rate

Food or the nutrient used	Dose and method used	Impact on the fertility parameter	References
Date Palm Pollen (DPP)	Biochemical Analysis	Flavonoids, Phenolic acids and steroidal compounds like estriol, estrone, triterpene and estradiol and all these are structural precursor's such as immature gonadotropic and a-amyrin structure that improve overall fertility Parameters.	Abbas & Ateya, 2011; Daoud, 2015
DPP	Administer 120 and 240 mg/kg to rats orally	Sperm Count and Motility Increased, Testis and Epididymis weight increased	Mehraban et al., 2014
DPP aqueous suspension	40 mg for 56 days after cadmium induced testicular toxicity.	Semen Parameters Improved, Restoration of Fertility	El-Neweshy et al., 2013
DPP	Administer 120mg/kg to albino rats daily	Sex Hormones Levels raised	Arfat et al., 2014
DPP	Orally Administration of DPP (150 mg kg^{-1}) + injection of L-thyroxine (L-T4, 300μg kg^{-1}; i.p.) + propylthiouracil (PTU, 10 mg kg^{-1}; i.p.) A Comparative study	Testosterone, FSH, LH as well as estradiol	El-Kashlan et al., 2015
DPP	Nicotine used to induce testicular toxicity-500mg/kg date pit powder given	Weight of testis and epididymis also increased through Date pit powder intake	Saeed et al., 2015
Aqueous extract of date palm pollen grain	Intraperitoneally Administration	Increase in ejaculation, intromission and frequency	Abedi et al., 2012
Aqueous suspension of DPP	120mg for 18 days and 35 days in prepubertal albino rats	Fertility parameter increased as compare to control group (P<.001)	Iftikhar et al., 2011
Methanolic extract of DPP	Streptozocin-induced male diabetic rats 0.2 mg /kg/day	Testosterone level, Testis weight, weight epididymis and seminal vesicles Increased	Kazeminia et al., 2014
Suspension of DPP	To diabetic rats equal to dose of 100mg/kg of body weight	Restoration of sexual loss due to diabetes	Mohamed et al., 2018

Table 5 Medicinal Properties of Date palm pollen and Dates

Medicinal property	Mechanism	Result	References
Antimicrobial	Methanolic extract of DPP Tested against the six species of bacteria	Strong antibacterial activity against Staphylococcus Epidermidis equal to 22 mm as of antibiotic.	Abed El-Azim et al., 2015
	Date palm pollen against 17 microorganisms	Inhibition of microbes is noted	Daoud et al., 2019
	Date Fruit	Antibacterial activity against five bacterial species	El Sohaimy et al., 2015
Anticancer Activity	Date Fruit	Presence of polyphenol act as free radicles scavengers.	Al-Alawi et al., 2017
	Ajwa date Extract	In Various types of cancer i-e lung, Prostate, gastric etc. their growth is inhibited	Zhang et al., 2017
	Extract of Date Palm Pollen	Anticancer activity towards breast cancer Inhibit the MCF-7 cells	Ghanem et al., 2015 Homayouni-Tabrizi et al., 2018
	Silver palm pollen nanoparticles		
Neuroprotective Activity	Date Palm pollen effect on neurotransmitter	Level of dopamine increased	Abedi et al., 2014
Anti-diabetic Activity	High amount of poly phenols that kills free radicles	Lower the blood glucose level	Zhang, 2017; Hasan & Mohieldein, 2016
	Act as inhibitors of α-glucosidase that involve in glucose absorption		Mohamed et al., 2018
Antioxidant Activity	Polyphenols, tannins, carotenoids (flavonoids, lignans and isoflavons) and sterols in dates And Date palm pollen	They act as free radicle scavenger and reduce the oxidative stress	Martín-Sánchez et al., 2014 El Sohaimy et al., 2015 Daoud et al., 2019
Anti-inflammatory activity	Date palm inhibit the Cyclooxygenase enzymes activity that promotes inflammation	Reduce the inflammation	Bouhlali et al., 2017 Rahmani et al., 2014
	Date palm Pollen act as act as anti-inflammatory		Elberry et al., 2011

Nephroprotective	Date palm pollen at the dose of 150 mg/kg of body weight after toxicity by lead acetate	Urea and creatinine level become normalized	Hammed et al., 2015 El-Arem et al., 2014
	Date extract used	lowering in the urea, uric acid and creatinine as well as in MDA also observed	

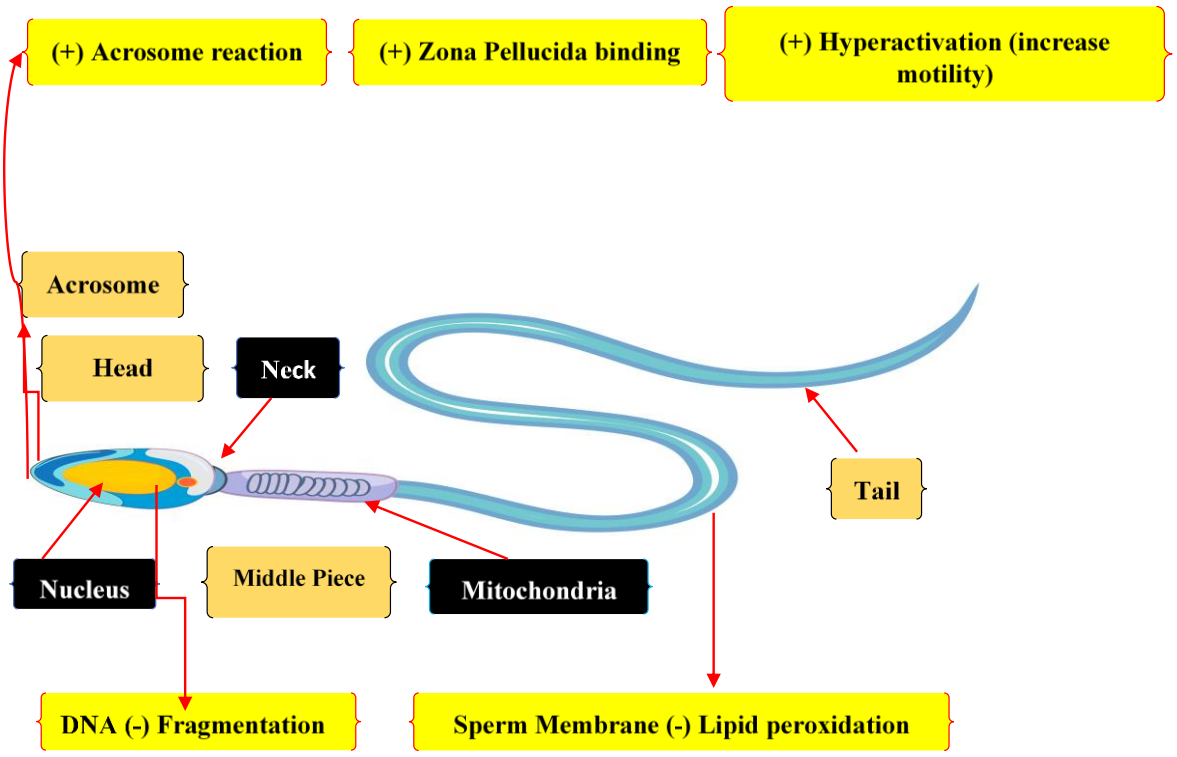

Fig. 1 Normal balance of ROS and antioxidants-optimal functioning of sperm (Modified from Wagner et al., 2018)

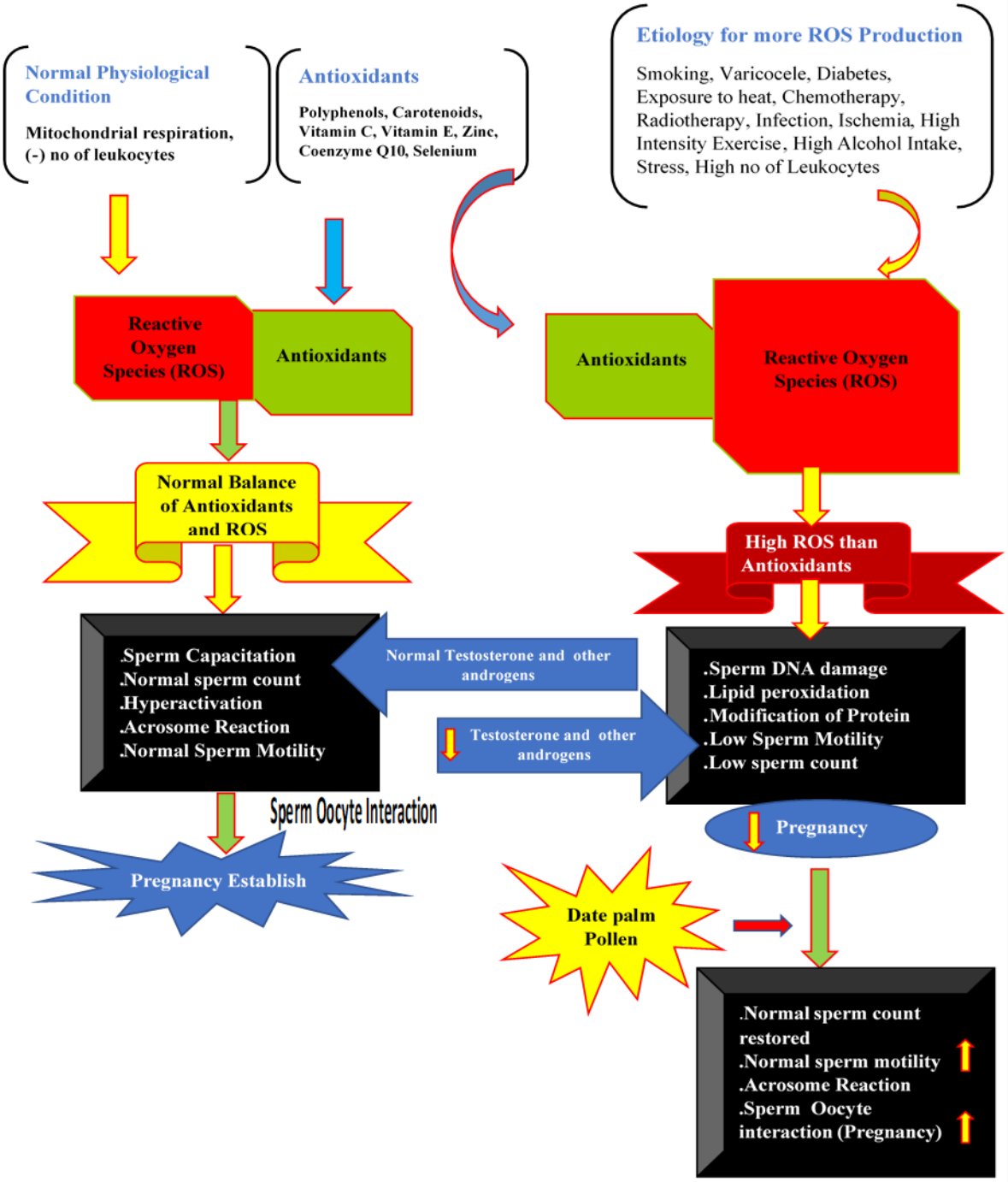

Fig. 2 REDOX balance and oxidative stress (Normal and abnormal function of sperm)

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