Topical Review Article

The Role of Date Palm (*Phoenix dactylifera* L) Pollen in Fertility: A Comprehensive Review of Current Evidence

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Abstract

Date palm pollen (DPP) is the male reproductive dust of palm flowers used as dietary supplement especially as aphrodisiac and fertility enhancer in both women and men from ancient times. Although there are few clinical trials evaluating the beneficial effects of DPP in humans, various experimental studies have been conducted on the reproductive effects of DPP. Among the compounds isolated from DPP are amino acids, fatty acids, flavonoids, saponins, and estroles. The present review summarizes comprehensive information concerning the phytochemistry and pharmacological activities of DPP and its application in fertility disorders.

Keywords

date palm pollen, pharmacological effect, chemical constituents, fertility, reproduction

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Date palm (*Phoenix dactylifera* L., from the family Palmae) pollens (DPPs) are the male reproductive cells of palm flowers. It is interesting to note that approximately 1000 tons of DPPs are reproduced every year by millions of palm trees grown in the Arabic regions.[1] DPPs were used by the early Egyptians and Chinese people as a rejuvenating medicinal agent. They are also used worldwide as dietary supplements.[2] DPPs and male palm flowers were traditionally claimed to be aphrodisiacs and fertility enhancers. DPPs have been used in the Middle East as a natural drug for treatment of male infertility and promoting fertility in women.[3] According to Iranian traditional medicine, this part of date has refreshing and nutritional value and is beneficial for the treatment of infertility in both males and females.[4] Moreover, it is widely used for curing male infertility.[5]

The present review summarizes comprehensive information concerning the phytochemistry and pharmacological activity of DPPs in the reproductive system and fertility disorders.

Phytochemical Constituents

Amino acids are the major constituents of this plant. Amino acids including aspartic, threonine, glutamine, proline, glycine, alanine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine, arginine, and serine were detected in Egyptian DPPs. Also, nutritive elements and vitamins such as B_1, B_2, and B_{12} have been detected in 4 types of Egyptian DPPs, with varying amounts depending on its type.[2] It was reported that palm pollen grains contain considerable amounts of vitamins A, E, and C; minerals such as zinc, selenium, iron, molybdenum, copper, manganese, cobalt, and nickel; amino acids such as leucine and lysine; and fatty acids including palmitic, linoleic, myristic acids.[6,7] Mohamadi et al demonstrated that the pollen possessed about 1.47% oil composed mainly of oleic acid (68.04%).[8]

Considerable amount of rutin is obtained from the alcoholic extract of the pollen.[9,10] Besides rutin, 4 other flavonoids were isolated from the ethyl acetate fraction (isorhamnetin, apigenin, luteolin, and naringin),[11] and quercetin was identified in the alcoholic extract of DPPs.[10] Polyamide column chromatography of the methanolic extract showed 6 phenolic compounds: caffeic acid, gallic acid, catechin, coumaric acid, chlorogenic acid, and quercetin.[12]

A noncrystalline estrogenic substance was also detected in DPP extracts.[13] Estrone and cholesterol were isolated from date palm seeds and pollen.[10,14,15] High-performance liquid chromatography analysis of the hexane fraction from Egyptian DPPs revealed the presence of estrone, estradiol, and estriol.[11]

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Table 1. Pharmacological Activities of Date Palm Pollens.

Plant Extract	Method	Duration	Dose	Results and Pharmacological Activity	Reference
Aqueous extract precipitated with acetone	Male and female rats	ND	Precipitation from 10 g pollen (oral administration)	↑ Weight of the gonads and accessory sex organs; spermatogenic activity and follicular development	Soliman and Soliman[1]
Two glucoproteins (A and B) isolated from DPPs	Mouse uterus method to consider human pituitary gonadotrophins	3 days	2 and 10 mg, once on the first day and twice daily for 2 days	↑ Weights of uterus by glucoprotein B; ↑ gonadotrophic activity by glucoprotein B in dose of 10 mg, equivalent to 0.88 IU of human pituitary gonadotrophins; 100% mortality in both doses of glucoprotein A after one day from injection	Mahran et al[10]
Aqueous extract	Male mice/oral administration of extract before cisplatin	ND	250 and 500 mg/kg oral route	Significant recovery of the testis histology; ↓ epididymal sperms with tail abnormalities; maintenance of normal epididymal sperm number at highest dose in treatment groups	Al-Kharage[26]
Pollen grains	Healthy and castrated male, and healthy and ovariectomized female rats/oral administration	ND	ND	↓ Serum testosterone in control male rats, but a slight increase in castrated rats; ↑ serum estradiol in both control and ovariectomized rats; ↓ progesterone level in control female rats and slightly increased in ovariectomized rats with slight increase of serum FSH and LH in both normal and ovariectomized female rats; ↑ serum globulin, total protein, and total lipids in ovariectomized rats; ↑ serum ALP activity in normal male rats; ↑ serum GPT in normal male, ovariectomized female and castrated rats; ↑ serum GOT activity in ovariectomized female and normal male rats	El-Desoky et al[27]
Aqueous suspension	Healthy male rat	35 days	30, 60, 120, and 240 mg/kg (oral administration)	↑ Motility ($P < .001$) in all treatment groups compared to placebo except 30 mg/kg group; ↓ DNA denaturation in all treatment groups compared to placebo. ($P < .001$) improvement of sperm morphology in 120 mg/kg and 240 mg/kg treatment groups compared to placebo ($P < .05$); ↑ sperm counts in all treatment groups compared to placebo; ↑ weight of left testis and epididymis ($P < .001$); ↑ weight of right testis and epididymis ($P < .05$); ↑ blood level of estradiol in 30, 60, and 120 mg/kg groups compared to placebo group ($P < .05$); ↑ blood level of testosterone in 120 mg/kg group compared to placebo group ($P < .05$); no significant effect on the weight of the prostate and the seminal vesicle or the histology of the reproductive tissues	Bahmanpour et al[19]
75% Methanolic extract of DPPs	Spermatogenic healthy male rabbits	8 weeks	5 mL/kg and 25 mL/kg daily	↑ Total count ($P < .01$); ↓ motility; and ↑ testis weights in both groups compared to placebo	Faleh and Sawad[21]
Aqueous suspension	Prepubertal Albino rats/single oral dose for 18 and 35 days, respectively, for 2 experimental groups	18 days and 35 days	120 mg/kg daily	↑ Body weight and serum testosterone levels in 35 days experimental group compared to control group ($P < .001$)	Iftikhar et al[22]
Aqueous suspension	Adult female rats exposed to lead acetate/oral administration	6 weeks	150 mg/kg daily	↑ LH and ↑ FSH in DPP + lead acetate group compared to lead acetate group ($P < .05$)	Hammed et al[17]
Aqueous extract	Healthy male rats	Single dose injection	35, 70, 105, 140, and 350 mg/kg/ intraperitoneal administration	↑ Sexual behavioral parameters include mounting, intromission, ejaculation, frequencies and latencies in all doses and ↓ mount and intromission latencies compared to placebo; ↑ testosterone, estradiol, and the orientation of males toward female ones by increasing mounting and anogenital investigatory behavior	Abedi et al[23]

(continued)

Table 1. (continued)

Plant Extract	Method	Duration	Dose	Results and Pharmacological Activity	Reference
Ethanolic extract	Male rat/cadmium-induced testicular toxicity	56 days	40 mg/kg once daily, oral administration after cadmium-induced testicular toxicity	Restoration of decreased sperm count and motility and increased rates of sperm abnormalities and oxidative stress (↑ malondialdehyde and ↓ reduced glutathione levels), histological alterations (necrosis, inefficient to completely arrest spermatogenesis and a reduced Johnsen's score[a]), and ↓ testosterone level induced by cadmium were seen in DPP + Cd compared to Cd group ($P < .001$ in all parameters)	El-Neweshy et al[28]
Aqueous suspension	Testicular dysfunction induced by cadmium chloride (Cd) in adult male rats	30 days	240 mg/kg, oral administration	↑ Left and right testis weight ($P < .01$); ↑ prostate gland weight ($P < .01$); ↑ seminal vesicle weight ($P < .05$); ↑ sperm count ($P < .01$); ↑ sperm motility ($P < .01$); ↑ estradiol concentration ($P < .01$), ↓ GSH ($P < .01$); ↓ SOD ($P < .01$), ↓ CAT ($P < .01$) in DPP + Cd group compared to Cd group. No meaningful differences between 2 groups about testosterone concentration, MDA, and NO level	Hassan et al[29]
Aqueous extract	BALB/c mice	35 days	100, 200, and 400 mg/kg/d, intraperitoneal administration	↑ Proportion of male infants than female infants in all treatment groups compared to control group ($P < .01$)	Hosseini et al[31]
Aqueous extract	Adult female BALB/c mice	21 days	100, 200, and 400mg/kg/d, intraperitoneal administration	↑ Testosterone, estrogen and progesterone ($P < .01$); ↑ secondary follicles ($P < .05$) and antral follicles ($P < .01$) only in the group that received 400mg/kg palm pollen extract compared to the control group	Hosseini et al[18]
Aqueous suspension	Healthy adult male rats	35 days	120, 240, and 360 mg/kg, oral administration	↑ Ratio of testis or epididymis to body weight, sperm count, sperm motility, and estradiol compared to control group ($P < .05$) at dose of 120 and 240 mg/kg; ↑ LH and testosterone levels only at 120 mg/kg of DPPs ($P < .01$ and $P < .001$, respectively); ↑ STD in the 3 doses ($P = .001$)	Mehraban et al[20]
Aqueous suspension	Healthy male Albino rats	35 days	120 mg/kg daily, oral administration	↑ Body weight, serum testosterone levels, weight of paired testis and intratesticular testosterone level in experimental group compared to placebo group after 35 days ($P < .05$)	Arfat et al[24]
Aqueous suspension	Prepubertal Albino rats	18 days and 35 days	120 mg/kg daily single oral dose for 18 and 35 days, respectively, for 2 experimental groups	↑ Johnsen score in 35 days experimental group compared to control group ($P < .001$)	Iftikhar et al[25]
Methanolic extract of DPPs	Streptozocin-induced male diabetic rats	4 weeks	0.2 mg/kg daily/oral administration	↑ Testosterone level ($P < .05$); ↑ testis weight ($P < .001$); ↑ weights of epididymis ($P < .05$); ↑ seminal vesicle weight ($P < .05$) in treatment group compared to diabetic group; no significant change in LH and FSH level	Kazeminia et al[30]
Aqueous extract of DPPs			0.06, 0.25, and 0.62 mg/mL	No significant change in the percentage of viability and proliferation in control and DPP-treated groups ($P > .05$); DPP had no toxic effects on viability percentage and the proliferation rate of these cells	Mahaldashtian et al[34]
DPP powder	Clinical trial on 25 infertile men with abnormal sperm count and/or motility with normal other semen parameters	3 months	500 mg twice daily	↑ Sperm count ($P < .05$); ↑ active sperm motility ($P < .05$); ↑ FSH ($P < .05$); ↑ LH ($P < .05$); ↑ testosterone ($P < .05$); and ↑ sexual desire ($P < .01$) after treatment compared to before treatment	Marbeen et al[32]
DPP powder	Clinical trial on 25 infertile men without testicular causes	3 months	500 mg DPP + 100 mg zinc sulfate twice daily	↑ Sperm count ($P < .05$); ↑ active sperm motility ($P < .05$); ↑ FSH ($P < .05$); ↑ LH ($P < .05$); ↑ testosterone ($P < .05$); and ↑ sexual desire ($P < .05$) after treatment compared to before treatment	Al-Sanafi et al[33]

Abbreviations: ND, not determined; DPP, date palm pollen; FSH, follicular stimulating hormone; LH, luteinizing hormone; ALP, alkaline phosphatase; GPT, glutamic-pyruvate transaminase; GOT, glutamate-oxaloacetate transaminase; Cd, cadmium; GSH, glutathione peroxidase; SOD, superoxide dismutase; CAT, catalase; MDA, malondialdehyde; NO, nitric oxide; STD, seminiferous tubules diameter.
[a]A scoring system for assessing spermatogenesis in testicular biopsy.

Investigation of DPP revealed the presence of β-amyrin and β-sitosterol. Also, a steroidal saponin glycoside having glucose and rhamnose as sugar moiety and 2 glucoproteins with unknown structure were isolated from DPPs.[10] El-Ridi showed that DPPs have gonadotrophic hormones including follicle stimulating hormone and luteinizing hormone.[16]

Pharmacological Activities

Table 1 lists the pharmacological activities attributed to DPPs.

DPPs showed gonadotrophic activity and caused increase in the weight of female sex organs.[1] DPP water suspensions could compensate decreased luteinizing hormone and follicle stimulating hormone in adult female rats exposed to lead acetate.[17] Aqueous extract increased the amount of testosterone, estrogen, and progesterone and secondary and antral follicle numbers in adult female mice.[18]

DPPs revealed spermatogenic activity.[1] Administration of DPPs to male rats and rabbits caused increase in sperm count, sperm quality, with a concomitant increase in the weights of testis and epididymis.[19-21] Aqueous extract of DPP in various doses improved sexual behavior, serum testosterone, intratesticular testosterone, body weight, and spermatogenesis in male rats.[22-25]

Extract of pollen grains significantly inhibited the cisplatin-induced genotoxicity and retained sperm motility and sperm count at the normal level. These findings suggest the preventive role of the pollen grains against the chemotherapeutic-induced infertility in males.[26]

El-Desoky et al showed the effect of DPPs on sexual hormonal balance, cholesterol, total lipids, total protein, albumin, globulin, and liver functions in control male and female rats, and castrated and ovariectomized rats.[27] DPPs restored spermatogenesis, sex organ weight, sperm motility, estradiol level, decreased catalase, glutathione peroxidase, and superoxide dismutase, and attenuated the toxic effects of cadmium on the male reproductive system by activating testicular endocrine and antioxidant systems.[28,29] Methanolic extract of DPPs protected testis structure and had a balancing effect on diabetes-induced change of the level of testosterone hormone in diabetic male rats.[30]

DPP suspension showed increase in the proportion of male infants than female infants. The authors attributed this effect to the rich content of potassium and sodium available in DPPs.[31]

There are little clinical trials about the effectiveness of DPPs on infertility. Two clinical trials showed that DPPs markedly improved sperm parameters (count, motility), sexual desire, and increased hormones (luteinizing hormone, follicle stimulating hormone, testosterone) in infertile men.[32,33]

In an in vitro study, aqueous extract of DPPs with various doses during 2 weeks had no toxic effects on viability percentage and the proliferation rate of neonatal mouse testicular cell suspension compared with the control group.[34]

Discussion

Traditional and folk medicines of different countries have great potential for introducing new natural remedies for various pathological disorders.[35-39] One of these remedies is pollen from *Phoenix dactylifera* L, which has been used in Iran ad Arabic countries for male infertility. Experimental studies showed that DPPs increase sperm count and motility and also sperm quality.[1,19] It could also reduce chemical-induced toxicity on the male reproductive system.[26,28] The pharmacological effects of DPPs are not limited to males, and it has also demonstrated activities on female sex organs.[1,10,18,27] Phytochemical studies showed the presence of sterol derivatives, flavonoids, and various amino acids in the pollen,[6-16] which may be responsible for these pharmacological activities. Despite various experimental studies, there are few clinical trials on DPPs and its beneficial effects on fertility. Thus, more clinical trials are needed to confirm the activities attributed to DPPs.

Author Contributions

RR designed study and edited the manuscript. MT and MH collected data and wrote the manuscript.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical Approval

This study did not require ethical approval as no animal or human subjects were involved.

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