Effect of feeding date palm fruit (Phoenix dactylifera L.) on menstrual health in a convenient sample of females

H. F. Al-Sayyed*, H. R. Takte1, N. A. Bakir1, D. H. Takte2
1Department of Nutrition, Faculty of Pharmacy and Medical Sciences, University of Petra, Amman, Jordan; 2Department of Nutrition and Food Technology, Faculty of Agriculture, The University of Jordan, Amman, Jordan

ABSTRACT

Background and objectives: It was reported that date palm fruit (Phoenix dactylifera L.) affected sex hormone levels in rat model. Thus, this research aimed to study the effect of daily feeding of date palm fruit to adult females on their monthly sex hormonal concentrations in addition to studying other menstrual parameters such as menstrual cycle length and the amount of bleeding.

Subjects and methods: A convenient sample of 37 female volunteers participated in the study. All of the participants were non-smokers, aged 20-30 years old. Each of them filled a consent form for the participation in the study. The participants were divided into 2 groups: the experimental group who were fed daily 7 dates of “Barhi” variety for 4 consecutive menstrual cycles and the control group (the group who were not fed the fruit). The hormones measured were: luteinizing hormone, follicle stimulating hormone, 17-β-estradiol, progesterone, and prolactin. Hormone concentration was measured by enzyme linked immunosorbent assay (ELISA) technique. Other menstrual parameters such as menstrual cycle length and the amount of bleeding were also estimated using a mobile phone application that was uploaded on the cell phones of the participants.

Results: Feeding date palm fruit affected menstrual hormone concentrations significantly (p<0.05) compared to the control group. The pattern of change in the hormone concentration didn’t differ according to the month of feeding (p>0.05).

Conclusions: Eating date palm fruit could be promising in improving menstrual health and fertility.

Keywords: Date palm fruit (Phoenix dactylifera L.); Luteinizing hormone; Follicle stimulating hormone; Progesterone; Prolactin; 17-β-estradiol; Menstrual characteristics

INTRODUCTION

Date palm tree is considered as an essential part of farming systems in arid and semi-arid regions (Daoud et al., 2015; Parle and Khanna, 2010). Of the date palm trees, the genus Phoenix is one of the most widely cultivated palms worldwide (Elgindi et al., 2015). Date palm fruit (Phoenix dactylifera L.) has been traditionally used for the treatment of different ailments such as memory disturbances, fever, inflammation, paralysis, loss of consciousness, and neurological disorders (Akunna & Saalu, 2012). In ancient Egypt, the fruit was used as an important ingredient in various aphrodisiacs (Elgindi et al., 2015) and tonic confections. Additionally, the regular consumption of P. dactylifera palm pollen and the male flowers were reported to enhance fertility (Bahmanpour et al., 2013; Elgindi et al., 2015; Parle and Khanna, 2010). Tackholm and Drar (1973) claimed that “The pollens of a male date palm mixed with water is a charm against childlessness”. Its gum is useful in the treatment of diseases of genitourinary system (Parle and Khanna, 2010). The date fruit is listed in folk remedies for the treatment of condylomata, gonorrhea, longevity, piles, sterility and urogenital ailments (Selvam, 2008; Parle and Khanna, 2010).

In the Middle East, it is common to consume about 10 to 30 dates daily as part of daily food pattern (Elgasim et al., 1995). Also, date palm fruit consumption is commonly used to break Ramadan fasting.

It has been found that date palm fruit (Phoenix dactylifera L.) affected sex hormone levels in rat model (Elgasim et al., 1995; Ammar et al., 2009; Abedi et al., 2012; Al-Sayyed et al., 2014; Daoud et al., 2015). Thus, this research aimed to study the effects of daily feeding of date palm fruit (Phoenix dactylifera L.) of “Barhi” variety to adult human females on their monthly sex hormonal concentrations and other menstrual parameters.

*Corresponding author:
H. F. Al-Sayyed, Department of Nutrition, Faculty of Pharmacy and Medical Sciences, University of Petra, Amman, Jordan.
E-mail: halsayyed@uop.edu.jo
SUBJECTS AND METHODS

This study was a feeding trial aimed to test the effect of feeding 7 date palm fruits (Phoenix dactylifera L.) of “Barhi” variety at “Tamri” maturity stage (to a convenient sample of females) on sex hormone concentrations and to detect any menstrual changes in terms of menstrual length, menses duration, and menstrual/blood losses. The study was carried out between September 2016 and January 2018. The number 7 (7 dates) was selected to follow the habit “Sunnah” of the messenger Mohammed (Peace be upon him) in eating the fruit. The variety “Barhi” was chosen because it is the most commonly grown variety of dates in Jordan and because it was shown in a previous work, done in our laboratories, that it has an effect on the hormone 17-β-estradiol (Al-Sayyed et al., 2014).

Forty females intended to participate in the research. A written announcement was signed by the researchers after acceptance of the research proposal from the scientific research ethical committee at the University of Petra/Amman/Jordan (Decision Number 20163NI). The announcement was hanged on all the bulletin boards at different faculties of University of Petra and the University of Jordan/Amman/Jordan. The study participants were menstruating females, apparently free of diseases, sexually inactive, aged 20-30 years old, non-smokers, don’t have any menstrual irregularities, don’t ingest medications that affect or regulate menstrual cycle, and not following any special diet.

Before the start of the study, the research idea was explained to the volunteers, the volunteers filled a form asking about some socioeconomic and menstrual characteristics. Additionally, they filled a consent form for participation in the study.

The study participants were given the choice to participate in any of the 2 study groups (i.e. date palm fruit group or control group). Before starting the study and at each follicular phase of the menstrual cycle (2nd-5th day) during the study, each participant donated a 5 ml blood sample to measure the concentration of the hormones: luteinizing hormone (LH), follicle stimulating hormone (FSH), progesterone (Prog), prolactin (Prol), and 17-β-estradiol (E2). Blood samples were drawn by a female qualified laboratory technician and blood hormone concentrations were measured by enzyme immunoassay technique (ELISA) technique at the MedLab® laboratories, Amman, Jordan.

Before starting of the research, a mobile application was developed and uploaded on the cell phones of the study participants to remind them to eat the fruit (date group participants), fill the menstrual changes forms, to donate the blood samples, and predict the date of the next menstrual cycle (DiFilippo et al., 2015). Menstrual bleeding was defined for all of the participants as the start of spotting due to vaginal bleeding that does not require sanitary protection (WHO definition) with some modification. The end of menses was defined for the participants in accord with the Islamic religion definition of menses ending. The assessment of menstrual blood loss was performed by pictograms with blood loss equivalents (Dasharathy et al., 2012) developed and provided by the research assistant.

Date palm fruit was purchased from a local farm in Jordan “Khayrat Assahra’a”. Each study participant of the date group was requested to eat 7 dates per day throughout the study period (four consecutive menstrual cycles). The participants in both groups were asked to exclude any of the following food items and their products from their intake; soybean, chocolate, sesame and sesame paste, chickpea dip, flaxseed, walnuts, seed bread, cinnamon and licorice. The participants of the control group were exposed to the same conditions of the trial except for eating the dates. Both group participants went through a “washout” period; this was the first month of the trial, in which they didn’t eat the dates, nor the prohibited foods. All data were coded and handled in a blind manner. Statistical analysis for the data was performed by the software package for social sciences (SPSS, version 23).

To detect the statistical significant differences between the study groups, data of initial (baseline) characteristics of the study participants were analyzed by Hotelling’s T-test. To detect the effect of feeding the fruit throughout the study period, monthly data were analyzed by mixed (effect of group and time) analysis of variance (ANOVA) for repeated measures design analysis (Laerd statistics, 2018). Significant differences were considered at \( P<0.05 \). Data of the baseline characteristics of the study participants are expressed in the tables 1 and 2 as mean ± standard deviation. Data of the hormone concentration and other menstrual characteristics throughout the feeding trial are expressed in the tables 3, 4, and 5 as mean ± standard error of the mean (SEM).

RESULTS AND DISCUSSION

Thirty seven menstruating single/not sexually active females completed the research; 16 in the control group and 21 in the date palm group. Table 1 shows the socioeconomic characteristics of the study participants. This table shows that both groups were not statistically different \( (P>0.05) \) from each other. All of the study participants were menstruating females aged about 21 years old, students at the University of Petra, The
Table 1: Socioeconomic characteristics of the study participants

<table>
<thead>
<tr>
<th>Characteristics/group</th>
<th>Date palm group (n=21)</th>
<th>Control group (n=16)</th>
<th>Probability (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>21.409±0.266</td>
<td>21.111±0.294</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Educational level (class)</td>
<td>Bachelor (students of 3.68±0.716 class)</td>
<td>Bachelor (students of 3.61±0.698 class)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Number of family members</td>
<td>6.136±0.350</td>
<td>6.00±0.387</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Order within the family</td>
<td>3.000±0.481</td>
<td>3.278±0.532</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Family income (JOD) 1</td>
<td>1215.909±214.197</td>
<td>1686.111±236.104</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

1 1 US dollar=0.71 JOD (Jordanian Dinar)

Table 2: Some menstrual characteristics of the study participants before starting of the study

<table>
<thead>
<tr>
<th>Characteristics/group</th>
<th>Date palm group</th>
<th>Control group</th>
<th>Probability (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at menarche</td>
<td>13.318±0.335</td>
<td>12.861±0.371</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Length of menstrual cycle</td>
<td>26.114±1.440</td>
<td>24.833±1.592</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Length of menses</td>
<td>6.432±0.245</td>
<td>5.972±0.271</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

Table 3 shows that feeding the fruit reduced significantly (P<0.05) the concentration of the hormones: LH (6.769±0.914 IU/L compared to 7.132±1.081 IU/L in the control group) (P<0.001**), Prog (0.804±0.449 nmol/L compared to 1.466±0.591 nmol/L in the control group) (P<0.008**), and Prol (272.346±34.983 mIU/L compared to 416.520±43.632 mIU/L in the control group) (P<0.001**). On the contrary, feeding the fruit increased significantly (P<0.05) the concentration of the hormones FSH (6.573±0.587 IU/L compared to 5.885±0.695 IU/L in the control group) (P<0.001**) and 17-β-estradiol (50.353±3.566 pg/ml compared to 42.102±4.220 pg/ml in the control group) (P<0.001**). Additionally, there was no effect of the feeding duration on the hormone concentrations (data are not shown).

University of Jordan, and Al-Ahliyya Amman University/ Amman/Jordan. The average size of the family in both groups was 6 members and the average of their order in the family was 3. Also, their income was higher 1000 Jordan dinar (JOD).

Table 2 shows some menstrual characteristics of the study participants. Similar to the socioeconomic characteristics of the study participants, there were no statistically (P>0.05) significant differences between the two groups. The study participants menstruated for the first time at the age of about 13 years old, menstruate every ~ 25-26 days for about 6 days.

The statistically insignificant (P>0.05) differences between the study groups in the initial characteristics of the study participants indicates that our sample was acceptable despite the fact that it was convenient.

The study participants had normal age of menarche, menstrual length, and menses duration. The sociocultural characteristics are thought to affect menstrual cycle as well as the menarche age (the age of first menses) which is usually between 12 and 14 years and it seems that our study participants belong to sound socioeconomic families as their menstrual length, menses duration, and age of menarche were normal. Additionally, the study participants were selected to not ingest any medicine that affects neither menses nor menstrual hormone concentrations.

Before the initiation of the study, participants were asked to exclude all the following traditionally consumed foods and their products from their intake: soybean, chocolate, sesame and sesame paste, chickpea dip, flaxseed, walnuts, seed bread, cinnamon, and licorice as these foods contain estrogen-like substances in amounts much higher than those in date palm fruit (Thompson et al., 2006).

Menstrual cycle is defined as the monthly cyclic change pattern in terms of the secretion of reproductive hormones and the related changes in the ovaries and uterus that lasts about 25-30 days in females at the reproductive age (Mitchell, 2013). The gonadotropin-releasing hormone (GnRH) secretion results in FSH and LH secretion. The secretion of FSH stimulates the synthesis and secretion of E2 and matures the follicle and oocyte. When the follicle reaches maturity, a surge of LH and FSH triggers ovulation. The residual follicle serves as the functional corpus luteum under the primary control of LH. The LH increases the synthesis of Prog hormone. The hormones Prog and E2 promote the thickening, vascularization, and the secretory ability of uterine wall for the purpose of the implantation of the fertilized oocyte. If fertilization doesn't occur, the corpus luteum degenerates due to the reduced LH supply, and progesterone and E2 concentrations fall sharply. The hormonal stimuli for uterine wall thickening is lost and menstruation occurs (Schmidt and Litwack, 2006) usually for 2-8 days (Reed et al., 2015).

Feeding the fruit decreased significantly (P<0.001**) the concentration of LH compared to the non-feeding (Table 3); but still the values of the hormone were within the normal range for both of the study groups (2.4-12.6 IU/L). The literature regarding this issue is conflicting. Date palm pollen was found to reduce LH concentration after short term treatment (14 days) and increased the concentration after a longer term treatment of animals (Hammad et al.,...
Table 3: Effect of feeding date palm fruit (*Phoenix dactylifera* L.) on the serum hormone concentration of the study participants

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Date palm fruit (<em>Phoenix dactylifera</em> L.)</th>
<th>Group</th>
<th>Control</th>
<th>Probability (P)</th>
<th>Normal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luteinizing hormone (LH) (IU/L)</td>
<td>6.679±0.914</td>
<td></td>
<td>7.132±1.081</td>
<td>&lt;0.001**</td>
<td>2.4-12.6 IU/L</td>
</tr>
<tr>
<td>Follicle stimulating hormone (FSH) (IU/L)</td>
<td>6.573±0.587</td>
<td></td>
<td>5.886±0.695</td>
<td>&lt;0.001**</td>
<td>3.5-12.5 IU/L</td>
</tr>
<tr>
<td>Progesterone (Prog) (nmol/L)</td>
<td>0.804±0.449</td>
<td></td>
<td>1.466±0.591</td>
<td>0.008**</td>
<td>0.181-2.84 nmol/L</td>
</tr>
<tr>
<td>Prolactin (Prol) (mIU/L)</td>
<td>272.346±34.983</td>
<td></td>
<td>416.520±43.632</td>
<td>&lt;0.001**</td>
<td>100.6-489.3 mIU/L</td>
</tr>
<tr>
<td>17-β-estradiol (E₂) (pg/ml)</td>
<td>50.353±3.566</td>
<td></td>
<td>42.102±4.220</td>
<td>&lt;0.001**</td>
<td>11.3-43.2 pg/ml</td>
</tr>
</tbody>
</table>

In another study, the treatment with date palm pollen extract increased the hormone concentration (Jiheel and Arrak, 2013).

Theoretically, the reduction in LH concentration would suppress Prog secretion, and degenerate the corpus luteum. These effects would be interesting to be studied in the context of fertility.

Since polycystic ovarian syndrome (PCOS) is related to increased LH: FSH ratio. Our results related to the LH and FSH can be promising in helping the ovulatory failure in PCOS patients and may result in regular menstrual cycles.

Feeding the fruit increased significantly (P<0.001**) FSH compared to non-feeding (in the control group) (Table 3). Both groups exhibited normal values of the hormone FSH (Table 3). Quiet similar to the findings of the current research, feeding date palm pollen extract increased significantly (P<0.05) the number of mice follicles without affecting the serum density of FSH. The results of the current research are probably in agreement with the results of Jashni et al. (2016) who fed date palm fruit extract to female rats with induced polycystic ovarian syndrome (PCOS) and found a significant increase in the level of FSH (Jashni et al., 2016). Also, Hammad et al., (2012) found a significant (P<0.05) increase in FSH in rats after treatment of rats with date palm pollen extract. Flavonoids, alkaloids (Moshfegh et al., 2015), saponins, and steroidal compounds (Jashni et al., 2016) of the date palm fruit were reported to increase FSH. Additionally, the linoleic acid that is present in dates probably contributed to the oogenesis pathways (Modaresi and Pooe-Naji, 2012). Interestingly, El-Ridi (1960) extracted 100 IU FSH/10 g date palm pollen.

The FSH hormone promotes folliculogenesis (Jashni et al., 2016) and ovulation (Schmidt and Litwack, 2006). Thus, it is probable that feeding the fruit promotes ovulation. However, further studies related to this issue are recommended.

Feeding the fruit in the current research reduced significantly (P<0.001**) Prog. concentration (Table 3). Nonetheless, both groups exhibited normal values for this hormone. On the contrary to our results, Housseini et al. (2014) found a significant increase in serum Prog. in rats after treatment with date palm pollen extract. Nonetheless, the reduction of the Prog. concentration due to the feeding is expected since the feeding reduced LH concentration (Schmidt and Litwack, 2006).

Prolactin (Prol) is a hormone that stimulates mammary cell differentiation and milk production (Schmidt and Litwack, 2006). Date palm fruit has been reported to be lactogenic (Elgasim et al., 1995) in pregnant and lactating mothers. In the current research, feeding the fruit reduced Prol. significantly (P<0.001**) compared to non-feeding (Table 3). Yet both groups exhibited normal values for Prol. It is possible that the effect of feeding the fruit has different effects on Prol when fed to not-sexually active females and those who are pregnant or lactating. In non-sexually active females, increased Prol. concentration suppresses FSH and ovulation. Thus, it is probably advantageous to feed date palm fruit to females who suffer from suppressed ovulation due to increased Prol. concentration.

Feeding the fruit increased significantly the concentration of the hormone E2 compared to non-feeding. Quite similar results to those of the current research, feeding date palm fruit and date palm products or their extracts increased serum E2 in female animal models (Ammar et al., 2009; Al-Sayyed et al., 2014; Hosseini et al., 2014; Daoud et al., 2015; Moshfegh et al., 2015). Additionally, the increases of FSH might have contributed to the increase of E2.

Date palm fruit (*Phoenix dactylifera* L.) contains many functional compounds such as flavonoids (Hamad et al., 2015) e.g. isouceretines (Ammar et al., 2009), lignans (Yasin et al., 2015), estrone (Wahlqvist and Dalais, 2001), estrone-like compounds, sterols and steroidal saponin glycoside (Moshfegh et al., 2015). Other date products such as pollens contain rutin (Abbas and Ateyah, 2011), amino acids, fatty acids such as linoleic acid (Fayadh and Al-Shwiman, 1989; Suleiman, 2012), saponins, and sterols (Abdi et al., 2017). These compounds are thought to promote gonadotropic actions (El-Moughy et al., 1991; Ali et al., 2013; Rahmani et al., 2014). Additionally, lignans are phenolic compounds that are found in date palm fruit and are thought to be a class of endogenous

Proceedings of SIDPC, Abu Dhabi, UAE: March 19 – 21, 2018
mammalian hormones (Stitch et al., 1980). The most common lignans are secoisolariciresinol and matairesinol; these two compounds can be converted by gut bacteria into enterodiol and enterolactone respectively (Sethell and Adlercreutz, 1988).

Recently, enterolactone precursors were identified in date palm fruit (Phoenix dactylifera L.) i.e. laticiresinol, pinoresinol and syringaresinol (Heinonen et al., 2001; Abbas and Ateyah, 2011; Al-Alawi et al., 2017).

The linoleic acid presence in date palm fruit might have contributed to the elevation of the effect of estradiol due to the feeding of dates because linoleic acid can be converted to estrogen (Su et al., 1999). Additionally, the tannins and flavonoids (isoflavones) were found to contribute to the estrogenic activity of date seeds (Ammar et al., 2009).

The hormone E2 promotes thickening, vascularization, and the secretory ability of the uterine wall for the purpose of the implantation of the fertilized ovum (Schmidt and Litwack, 2006). Thus, feeding the fruit probably contributes these effects and further future studies might elaborate the possible related mechanisms.

Date palm fruit contains vitamin E, carotenoids, and selenium that work as antioxidants. Several studies showed the antioxidant properties of date palm fruit at the in vivo (Vayali, 2002; Abu—El—Soaud et al., 2004; Saafari et al., 2011) and in vitro levels (Khanavi et al., 2010; Qusti et al., 2010).

Thus, it is probable that the fruit enhanced the oxidative status of the ovarian tissue and balanced these hormones (Jashni et al., 2016).

Table 4 shows the effect of feeding the fruit on some menstrual characteristics. Feeding the fruit reduced significantly (P<0.05) total bleeding volume (42.071±20.304 ml compared to 70.083±21.931 ml in the control group) (P=0.003**), loss of blood in the maximum blood loss day (19.339±6.925 ml compared to 26.250±7.480 ml in the control group) (P=0.001**), menstrual secretions (10.659±3.123 ml compared to 23.312±5.179 ml in the control group) (P<0.001**), and menstrual cycle length (28.969±1.333 days compared to 31.233±1.377 days) (P=0.001**). Feeding the fruit didn’t affect significantly (P>0.05) the menses duration (6.750±0.270 days compared to 6.617±0.287 days) (P=0.051). Again, there was no effect of the feeding duration on all of these menstrual characteristics (data are not shown) except for menstrual length (Table 5). Feeding duration affected significantly (P<0.001**) the menstrual length. Also, the duration of the experimental conditions affected significantly (P<0.001**) the menstrual length of the control group.

Feeding the fruit reduced significantly the menstrual blood loss (P=0.003**) (in the menses and at the maximum day of blood loss) and menstrual daily secretions compared to non-feeding (control group) (Table 4). Heavy menstrual blood loss is a problem which necessitates medical treatment (Maybin and Critchley, 2016). The normal blood loss during the menstrual phase of menstrual cycle is <80 ml (Reed et al., 2016). Heavy loss increases the risk of iron deficiency anemia (Perurampää et al., 2014). Both study groups had normal bleeding volume. The consumption of date palm fruit was reported to decrease post-delivery bleeding volume (Al-Fasih and Lee, 2012). Results of the current research show that the effect of feeding date palm fruit on menstrual bleeding in nonsexually active females are in agreement with those of women post-delivery. The astringent tannins, linoleic acid, oleic acid, and stearic acid (Kadem et al., 2007; Hernandes et al., 2010) of date fruits probably contribute to such an effect. Thus, feeding the fruit might be used as a complementary remedy to help in the problems of heavy menstruation.
Moreover, feeding the fruit reduced significantly (P<0.05) the menstrual cycle length compared to non-feeding (control group, Table 5) although the effect is not great and both groups had normal menstrual cycle length (i.e. 25-30 days, Reed et al., 2016). The feeding duration seems to have an effect on menstrual cycle length. As well, the duration of experimental conditions (probably the prohibited foods) affected the length of menstrual cycle length (Table 5).

The sample size, convenience, and the season of the research implementation are thought to be limitations of the study. Nonetheless, this is probably the first feeding trial that tested the effect of feeding date palm fruit (Phoenix dactylifera L.) of “Barhi” variety on menstrual hormones and menstrual characteristics. It can be concluded that feeding affected significantly menstrual hormone concentrations and most of the studied menstrual characteristics. Thus, date palm fruit could be tested probably in the future to ameliorate health problems that are related to menstrual cycle as it is effective, accessible, and inexpensive.

ACKNOWLEDGMENT

The researchers would like to thank the Deanship of Academic Research at the University of Petra/Amman/ Jordan for financially supporting this research. (Project number 4/4/2015-2016).

REFERENCES CITED


Hosseini, S., Mehrabani D. and Razavi F. 2014. Effect of date palm pollen extract on sexual hormone levels and follicle numbers in adult female BALB/c mice. Quarterly of the Horizon of Medical Sciences. 20: 139-143.


