Research Article

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Consumption of Palm Date Herbal Beverage: Effect on Maternal and Infant Nutritional Status

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Abstract

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This research aimed to examine the effect of a palm date beverage containing herbal beads on maternal and infant nutritional status. A randomized placebo-controlled trial was conducted in exclusively breastfed infants (aged one to six months) and their mothers. 47 mother–infant pairs who were randomly allocated to the experimental (n = 24) and placebo (n = 23) groups completed the study. The mothers in the experimental group consumed palm date beverage containing herbal beads consisting of banana flower, lemon basil, and Thai basil (65 ml/bottle), two bottles/day, for four weeks and the other group consumed a placebo drink. Maternal and infant nutritional status was measured before and after the intervention using a body composition analyzer and digital baby scale, respectively. Maternal nutritional status, determined by weight, percent body fat, body fat mass, body muscle mass, visceral fat rating and BMI, was not significantly different between the experimental and placebo groups. Moreover, for infant nutritional status, weight-for-age percentile was not significantly different in both groups. In conclusion, a palm date beverage that contained herbal beads had no effect on maternal and infant nutritional status. The study period should be extended and we recommend that a future study investigates infant weight in the early postnatal period (infant age less than one month).

Introduction

Human breast milk is precious food for infants, especially during the first six months of life. Breast milk has many benefits because it provides essential nutrients and immunity for infants, all of which are suitable for their growth and development[1]. According to a UNICEF survey in Thailand, the rate of exclusive breastfeeding during the first six months was only 23.1% in 2017[2]. A cross-sectional study has shown 45.5% of Thai mothers stop breastfeeding before the recommended time because they perceived insufficient milk supply[3]. This problem may affect breastfeeding practice of Thai mothers, but in fact there are many herbs and plants that are traditionally used for increasing breast milk production in Thailand. A cross-sectional survey in Thailand suggested that mothers who consumed a diet containing galactagogues, namely banana flower, lemon basil, Thai basil, bottle gourd, and pumpkin, produced milk in quantities that were greater than those who consumed fewer of these items[4]. As previously shown, galactagogues have been shown to play a role in increasing breast milk production; for example, shatavari, torbangun, fenugreek, and palm date[5]. Palm dates are one especially effective natural galactagogue. Mothers who consumed palm dates as a supplement had greater breast milk production which could lead to faster weight gain among their infants[6]. Palm date is a source of carbohydrates, proteins, and vitamins and minerals such as vitamin B complex, vitamin C, vitamin K, calcium, phosphorus, magnesium and potassium. Besides, it also contains phytochemicals and important antioxidants such as carotenoids, polyphenols, especially phenolic acids, isoflavones, flavonoids and tannins[7]. These phytochemicals may increase milk volume. In addition, palm dates also have a sweet taste from their natural sugar content, mainly sucrose[8]. Therefore, they are widely used in galactagogue products because they improve the taste of the product. In conclusion, there is much interest in promoting the use of natural galactagogues, such as palm date, as dietary supplements for lactating mothers.

Postpartum weight retention is the measure of weight acquired during pregnancy that the mother has at a given time point post-pregnancy[9]. The suitable gestational weight gain for ordinary pre-pregnancy BMI women is 11.5-16.0 kg, based on the recommendation of the Institute of Medicine (IOM 2009)[10]. The mother's weight should be reduced in the sixth week postpartum and return to pre-pregnancy weight[11]. However, previous studies have found that only 15-28% of pregnant women are able to return to their pre-pregnancy weight[11-13]. Postpartum weight gain is an important problem in new mothers. This problem can lead to long-term obesity and related chronic diseases[14-17]. In contrast, breastfeeding influences weight loss in the postpartum period. Jarlenski et al. suggested that mothers who exclusively breastfed their infants for at least three months had greater weight loss at 12 months postpartum[18]. Also, Tørris et al. noted that mothers who breastfed for an average of less than 10 months had higher mean levels of fasting serum glucose, serum triglyceride, serum cholesterol, and waist-to-hip ratio than those who breastfed for 10 months or more[19]. This finding suggests that women who breastfeed for a shorter time may have poorer metabolic profiles. Thus, facilitating the induction of breastfeeding practice may help to improve their metabolic profile. Research has also found an association between phytochemicals, including saponin, and increasing milk production. A previous study showed an effect of saponin on lipid metabolism and obesity[20]. For experimental products, palm date herbal beverages consist of phytochemicals, especially saponin, which may positively affect postpartum weight retention.

Breast milk is the best source of nutrition to promote optimal growth for most babies. The body weight of infants should rise each month in accordance with their growth and development. In Thailand, the prevalence of stunting and underweight among children under the age of five-years-old was 10 to 15%[21]. For growth monitoring, infant weight and weight-for-age (W/A) are anthropometric indices that reflect growth. Growth charts are also used to easily assess infant and child growth. If infants gain weight within the normal range, they are at low risk of malnutrition.

For these reasons, galactagogues are options for enhancing breast milk production. If breast milk production increases, it will facilitate mothers' breastfeeding practice. Besides, breastfeeding practice is also beneficial to both mother and infant. Several studies observed that galactagogues increased breast milk production. However, there have been few studies that examined maternal and infant nutritional status. Therefore, this study examined the effect of consumption of palm date beverage containing herbal beads on maternal and infant nutritional status.

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Materials and Methods

Ethical considerations

The study followed the regulations of the Declaration of Helsinki and was approved by the Ethical Review Committee for Human Research, Faculty of Public Health, Mahidol University (MUPH 2019-025; 5 Feb 2019). The consent form was signed and approved by all participants before the study started.

Subjects

The participants of this double-blind randomized placebo-controlled trial lived in areas within the Bangkok Metropolitan Region of Thailand, namely Bangkok, Pathum Thani and Nonthaburi. Recruiting subjects to this study was performed by attaching announcements in mother and child groups via the Facebook application. Mothers answered short questions on an online screening form for selection, based on the inclusion and exclusion criteria. The researchers contacted subjects who passed the screening step. The subjects were recruited for the main research project, which studied breast milk volume and quality in mothers who had mature milk (more than 21 days postpartum[22]) to reduce milk supply variation in the early postpartum period. The data were collected from July to September 2019. The inclusion criteria of mothers were as follows: (1) had an infant aged one to six months (producing mature milk), (2) exclusively breastfeeding, and (3) no disease or illness affecting breastfeeding practice. Exclusion criteria of mothers were as follows: (1) having used a galactagogue drug or supplement, (2) history of high-risk pregnancy (GDM, pre-eclampsia), (3) multiple pregnancy, (4) inverted nipple or breast problem, (5) history of food allergy including allergy to palm date, banana flower, lemon basil and Thai basil, and (6) history of smoking, drinking alcohol, and drug addiction. All infants enrolled into the study were one to six months old and were exclusively breastfed. Infants with: (1) cleft lip or palate, (2) gross congenital malformations or genetic syndromes, (3) preterm or low birth weight, and (4) a twin sibling were excluded. This study was sub-research of a main project which used similar subjects. Sample size was calculated using a formula from Lemeshow[23] and applied an estimate of a single mean. The average milk volume of intervention mothers, who drank at least three cups of fenugreek herbal tea per day for three days was 73.2 ± 53.5 ml from the study of Turkyilmaz et al[24], and it was used as a reference value, followed by $\alpha = 0.05$ and $\beta = 0.10$. 18 participants

in each group were the least number of participants. An additional 60% was added to the sample size, to account for error in data collection and loss of follow-up of participants. Finally, 59 mother-infant pairs were included and randomly allocated to two groups: the experimental and placebo groups. The experimental group consisted of 30 mothers who were recommended to consume palm date beverage containing herbal beads. The placebo group consisted of 29 mothers who received a placebo (sugar solution) beverage. All mothers were recommended to drink the assigned beverage (two bottles/day) for four weeks.

Intervention

The beverages that were used in this study included palm date beverage containing herbal beads and a placebo (65 ml/bottle) sugar solution beverage. Both beverages contained the same amount of energy per serving (50 kcal). The beverages were sterilized according to the specified conditions for safety. Palm date beverage containing herbal beads (one bottle) was analyzed. Its nutritional value was as follows: 50 kcal of energy, 13 g of carbohydrate (sugar), 0 g of fat, 0 g of protein, 25 mg of sodium, 10 mg of calcium, 0.1 mg of iron, 80 mg of potassium and 0.08 mg of riboflavin, and the beverage also passed the criteria regarding microbial content and heavy metal contamination, as specified in the notification of the Thai Ministry of Public Health (No. 355, Year 2013) titled food in a hermetically-sealed container. Moreover, the palm date beverage containing herbal beads also contained total phenolic compounds (29.77 ± 0.24 mg gallic acid equivalent, total flavonoid compounds 12.10 ± 0.52 mg catechin equivalent, and saponin 4350.50 ± 296.10 mg aescin equivalent, respectively). All subjects were requested to avoid consuming any other galactagogue supplement until the end of the study.

The compliance rate was monitored by using a messenger application and telephone. Compliance rate was calculated from the number of participants who completely collected data and complied with beverage consumption.

Data collection

A TANITA DC-360 body composition analyzer was used to collect maternal anthropometric data including weight, percent body fat, fat mass, muscle mass, visceral fat rating and body mass index (BMI).

A stadiometer was used to measure height at the beginning of the study. At week 0, week 2 and week 4, the researcher interviewed mothers about the type and amount of all foods, drinks and/or food supplements using 24-hour recall. The Thai short International Physical Activity Questionnaire (IPAQ)[25], which has been tested for reliability and validity by the Department of Physical Medicine and Rehabilitation, Phramongkutklao Hospital, Bangkok, Thailand, was used to record mothers' physical activity. The researchers evaluated the result by using IPAQ short form categorical scoring[26] classified into low, moderate and high physical activity. A ZEPPER EB-20 digital baby scale with an accuracy of within 100g was used to measure infant weight. Infant weight was converted to W/A percentile using the WHO Infant Growth Chart Calculator[27].

Data analysis

The Kolmogorov–Smirnov test was used to assess data normality. INMUCAL-N version 3: NB.3[28] was used to calculate nutrient and energy intakes from the 24-hour recall. Statistical data were interpreted by using SPSS version 18 for Windows (SPSS Inc., Chicago, IL) with $p<0.05$ considered to be statistically significant. An independent sample t-test was used to compare maternal and infant nutritional status between the experimental and placebo groups. Categorical variables were compared using the Chi-square test.

Results

12 pairs were lost to follow-up, therefore data from 47 mother-infant pairs were analyzed. The compliance rate of mothers was 80%. A comparison of demographic characteristics between the experimental and placebo groups is shown in Table 1. There were no significant differences in mothers' age and infants' age. Besides, there were no significant differences in mothers' family status, career, and parity, except for maternal education ($p = 0.036$). The number of mothers who were educated to bachelor's degree level or higher in the experimental

Table 1 Demographic characteristics between experimental and placebo groups

Characteristics	Group		
	Experimental	**Placebo**	***p***
n	24	23	
Age of mothers (years), mean ± sd	31.71±4.82	31.04±5.06	0.647[a]
Age of infants (months), mean ± sd	3.77±1.72	3.86±1.92	0.860[a]
Family status, n (%)			
Married	23 (95.8)	22 (95.7)	1.000[b]
Divorced	1 (4.2)	1 (4.3)	
Education, n (%)			
Below bachelor's degree	3 (12.5)	9 (39.1)	0.036[c]
Bachelor's degree or higher	21 (87.5)	14 (60.9)	
Career, n (%)			
Unemployed/Housewife/Other	7 (29.2)	13 (56.6)	0.151[c]
Government official/State-enterprise employee/Self-employed	7 (29.2)	5 (21.7)	
Business officer/Merchant	10 (41.6)	5 (21.7)	
Parity, n (%)			
1	13 (54.2)	7 (30.4)	0.100[c]
2 or more	11 (45.8)	16 (69.6)	
Sex of infant, n (%)			
Male	9 (37.5)	8 (34.8)	0.846[c]
Female	15 (62.5)	15 (65.2)	

[a]Independent sample t-test; [b]Fisher's exact test; [c]Chi-square test

group was greater than in the placebo group (n = 21 and n = 14, respectively). There was no significant difference in the number of male and female infants in the two groups.

Maternal nutritional status was assessed using a TANITA DC–360 body composition analyzer and expressed as height, weight, body fat, body fat mass, body muscle mass, visceral fat rating, and BMI as shown in Table 2. There were no significant differences in the nutritional status of mothers between groups both at baseline and week 4. When comparing before and after the intervention, maternal nutritional status also did not significantly change within the experimental and placebo groups.

Infant nutritional status at baseline and week 4 is shown in Table 3. Infant weight was not significantly different between the experimental and placebo groups. However, W/A percentile between groups was significantly different both at baseline and at week 4. When comparing before and after the intervention, infant nutritional status was not significantly different within

the experimental and placebo groups.

The energy and nutrient intakes of mothers were collected at baseline, week 2, and after the intervention (data not shown). When compared in each week, energy and most nutrients between groups were not significantly different, except for fat. Mothers in the placebo group consumed fat more than the experimental group at baseline and week 2. On the other hand, fat consumption of mothers in both groups was not significantly different after the intervention. There were no significant differences in energy and nutrient intakes between week 0, week 2, and week 4 within the experimental and placebo groups.

Before the study, most mothers in the experimental group had low physical activity similar to the placebo group. At week 2, most mothers in the experimental group had moderate physical activity, while most mothers in the placebo group had high physical activity but there was no significant difference. At week 4, the number of mothers

Table 2 Maternal nutritional status of experimental and placebo groups at baseline and week 4

Indicators	Baseline			Week 4		
	Experimental group (n=24)	Placebo group (n=23)	p^a	Experimental group (n=24)	Placebo group (n=23)	p^a
Height (cm)	160.92 ± 6.95	160.91 ± 5.33	0.998	–	–	–
Weight (kg)	62.38 ± 10.57	60.27 ± 10.60	0.449	62.42 ± 11.23	59.68 ± 10.66	0.396
Body fat (%)	34.54 ± 6.23	33.17 ± 7.39	0.495	34.17 ± 6.86	32.92 ± 8.34	0.577
Body fat mass (kg)	22.05 ± 7.44	20.61 ± 7.75	0.519	21.93 ± 8.00	20.38 ± 8.25	0.518
Body muscle mass (kg)	37.96 ± 3.77	37.35 ± 3.81	0.587	38.11 ± 3.89	37.01 ± 3.54	0.317
Visceral fat rating	5.46 ± 2.30	4.96 ± 2.42	0.470	5.50 ± 2.41	5.05 ± 2.46	0.526
BMI (kg/m^2)	24.14 ± 4.14	23.30 ± 4.09	0.485	24.18 ± 4.38	23.27 ± 4.23	0.473

[a]Independent sample t–test

Table 3 Infant nutritional status of the experimental and placebo groups at baseline and week 4

Indicators	Baseline			Week 4		
	Experimental group (n=24)	Placebo group (n=23)	p^a	Experimental group (n=24)	Placebo group (n=23)	p^a
Weight (kg)	6.39 ± 1.11	6.00 ± 1.19	0.241	6.96 ± 1.00	6.54 ± 1.11	0.163
W/A percentile	53.98 ± 23.36	39.66 ± 22.59	0.038*	54.13 ± 21.87	40.21 ± 23.70	0.042*–

[a]Independent sample t–test

who had high physical activity in the placebo group was greater than in the experimental group but there was no significant difference. In summary, the physical activity of experimental and placebo groups was not significantly different during the study period (data not shown).

Discussion

Demographic characteristics consisted of mothers' age, infants' age, family status, education, career, parity, and sex of the infant. The mothers in the study lived in the Bangkok Metropolitan Region, where food and lifestyle are similar. Most characteristics of participants were similar because of using matched pairs in the method of subject allocation. Infants in this study were in the first six months of life, and mothers always fed only breast milk in accordance with the WHO recommendation[29]. All participants consumed similar amounts of energy and nutrients, except for fat, throughout the period of the study. At baseline and week 2, mothers in the placebo group consumed more fat than the women in the experi-mental group. Based on the 24-hour recall baseline data, mothers in the placebo group mostly ate high fat meals which affected their fat intake. However, the overall fat intake of both groups after the intervention was not significantly different. These results showed a similar eating pattern during the period of study in each group.

In this research, maternal nutritional status, including weight, body fat, body fat mass, body muscle mass, visceral fat rating and BMI, were not significantly different when compared between the experimental and placebo groups. Mothers were also asked whether they experi-enced any adverse effects after consuming the beverage. The most common problem in both groups was a lot of gas or frequent flatulence and there was no difference between the groups. The adverse effect may have come from tamarind juice which has tartaric acid and malic acid[30]. These acids affect the digestive system by increasing acid and gas in the colon and may have caused mothers to have a lot of gas or pass gas frequently. From the aforementioned studies, palm date and galactagogue consumption help to increase breast milk production[5,24,31] and initiate breastfeeding practice of mothers. However, there might have been individual factors that could not be controlled, which are physiological factors, genetics, and developmental history. Moreover, external factors consisting of diet, physical activity level, environment and social factors may affect maternal nutritional status[32]. In this study, energy intake and physical activity were not

significantly different when comparing before and after the intervention in the experimental and placebo groups.

Energy intake and lifestyle pattern remained rather constant throughout the study period, which helped to reduce confounding factors that affect maternal nutritional status. However, environmental and social factors such as family culture and socioeconomic status cannot be controlled. These individual and uncontrollable factors may have led to null results. Also, it may be because the period of study was only four weeks, which is a short period. If the study period was extended, it may show significantly different results. In summary, palm date beverage containing herbal beads had no effect on maternal nutritional status.

Infant weight was used as a marker of infant nutritional status. In this research, infant nutritional status including weight and W/A percentile were not significantly different when compared between the experimental and placebo groups after four weeks. A previous study, conducted in Egypt, showed that even though infants whose mothers consumed palm dates had weight gain greater than the control group on the seventh day postpartum, there was no significant difference on the fourteenth day postpartum[5]. Besides, a study in Turkey showed that infants of the galactagogue supplemented mothers had lower weight loss and regained their birth weight earlier than the control group infants only in the first week of life[24]. Similarly, a recent study by Modepeng suggested that infants whose mothers consumed palm dates did not experience significantly increased W/A compared with infants in the control group, but palm date mothers had greater breast milk volume in contrast with control mothers[31]. As previously mentioned, a galactagogue diet may affect infant weight only in the early postnatal period.

There are two possible explanations for the results related to infant nutritional status in this study. First, direct factors that affect infant nutritional status, other than breastfeeding practice, are birth weight, antenatal care, and delivery care[33]. These factors were not examined in this study. Therefore, in a future study, researchers should inquire about these factors for controlling confounding factors. Secondly, the findings were null possibly because four weeks may be too short to see a change in weight. If the study period is during the early postnatal period (infant age less than one month) and extended in duration to more than four weeks, it may clearly reveal the percent change of W/A percentile. According to the study, W/A

percentile was used to clarify quantitative changes of infant nutritional status between the pre- and post-study periods. For further study, z-score of W/A should be used to explain the nutritional status of infants. Thus, palm date beverage containing herbal beads had no effect on infant nutritional status.

This research is the first study conducted to study the effect of a palm date beverage containing herbal beads on maternal and infant nutritional status. It has several strengths. The placebo product that was used in this study was similar to palm date products, thus the mothers could not guess which group they were in. The data were collected in a real-life community setting, showing the real results of their daily life. Besides, the participants had similar characteristics among groups and few subjects were lost to follow up because of regular contact with them via a social media application and telephone. However, there were several limitations. The consumption of other galactagogues, dietary intake and physical activity could not be completely controlled in both groups. Moreover, as mentioned, the study duration was short.

Conclusion

Palm date beverage containing herbal beads had no statistically significant effects on maternal and infant nutritional status after four weeks of consumption. However, this is the first study conducted on the effect of a palm date beverage containing herbal beads and maternal and infant nutritional status. Future studies should record the consumption of all galactagogues other than the intervention beverage, in addition to improving the measurement of mother's compliance. Finally, an extension of the study period together with early postpartum investigation may be warranted.

Author contributions

CT developed the content of the experimental tools and questionnaire, conducted the study following advice from PP and AB, analyzed data, wrote and edited the manuscript. PP innovated the study design, developed the content of the experimental tools and questionnaire, rechecked the results of the analysis and helped to revise the manuscript. AB developed the study design and advised on the discussion. All authors rechecked and approved the manuscript prior to submission for publication.

Conflicts of interest

The authors declare they have no conflict of interest.

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