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The Relationship between Feeding Types and Infants' Growth Patterns in Jeddah, Saudi Arabia

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ABSTRACT

In the current study, the composition of polyphenols of Tamarix Gallica, including phenolic acids and flavonoids, was fully examined. Colorimetric methods were applied to assess the total phenolic and flavonoid contents; the individual polyphenols were determined in various phenolic groups through HPLC analysis, and their quantities were measured. In this plant, a total of five phenolic compounds were identified for the first time. The main peaks which were removed at 18.53 min, were considered as vanillic acid. There were two other main peaks which were eluted at 35.78 and 17.27 min that were considered as naringin and caffeic acid respectively. In these compounds, three components with retention times of 23.46, 25.81 min were determined. A practical tool for the metabolite characterization of Tamarix gallica can be applied in the developed technique to demonstrate a potential source of bioactive compounds to be used in phytotherapy.

Keywords: *Tamarix Gallica, Flavonoids, Phenolic acids, Extraction, HPLC.*

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1. INTRODUCTION

The first two years of a child's life is a critical stage for development and growth. Optimal nutrition during this stage is important to ensure good health and proper growth during childhood and throughout adulthood (Radwan,2013). Exclusive breastfeeding has been recommended by international organizations such as the World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF), and the American Academy of Pediatrics (AAP) for 6 months, with continued breast-feeding supplemented with complementary feeding up for 2 years.

Breast milk provides the infants with the nutrients needed for the first six months after which it becomes insufficient to meet infant nutritional requirements and thus becomes more likely to lead to deficiencies in energy, protein, iron, zinc, and some fat-soluble such as vitamins A and D (Rao *et al*., 2011). Many people believe that infant formula is equivalent to breast milk in its health benefits because commercially prepared formula has been enhanced in recent years, however, that is an incorrect belief (Gibson, 2005). Breast milk contains different levels of nutrients depending on the gender of the infants to meet different growth needs. Also, it is high in fatty acids that are essential for brain development. Omega-3 Docosahexaenoic acid (DHA) and Arachidonic acid (AA) essential fatty acids may help increase cognitive skills in infants. Additionally, higher intelligence quotient scores (IQ) have been reported in infants who were exclusively breastfed for 3 months or longer (Isaacs *et al*., 2010).

According to UNICEF statistics of Middle Eastern and North African countries, the percentage of children who exclusively breastfed for the first six months of life has decreased (UNICEF, 2007). Systematic reviews suggested that a longer duration of breastfeeding was associated with a reduction in the risk of overweight and obesity later in life (Oddy *et al*., 2014). Furthermore, many benefits of breastfeeding have been recorded for mothers. Mothers who have successfully practiced breastfeeding showed decreased risk of breast and ovarian cancer in the premenopausal period, and of osteoporosis in the postmenopausal period (Turck *et al*., 2013). Also, successful breastfeeding can be protective against postpartum anxiety and depression (Ystrom, 2012), and help in uterine involution after the birth (Negishi *et al*.,1999). There has been evidence that breastfeeding promotes weight loss (Neville *et al*., 2014). Therefore, this study aimed to identify the relationship between feeding types and infant growth patterns in Jeddah, Saudi Arabia.

2. SUBJECTS AND METHODS

2.1. Subjects and seting

The approval of the directorate of Health Affairs in Jeddah to allow the collection of the subjects from three health centers (Maternity & Children's Hospital in Jeddah - Al Musaddiyah, Al-tawfig PHC center and Sharq Al-Khat Al-Sare'e PHC center) was obtained.

2.2. Questionnaire

A questionnaire consisting of three main sections (demographic data, anthropometric measurements of the infants and feeding practices) was used with some modifications according to (Kuchenbecker, 2015 and Azzeh,2017). The interviews were administrated face-to-face. The questionnaire was tested on a pilot sample of 12 subjects prior to the data collection. The infants' weight and height were measured according to Ismail et al. (2013).

2.3. Anthropometric indicators

Based Anthropometric Z-scores for the infants were generated using the WHO open source software (WHO, 2018). The following indicators were used to define the infants' nutritional

status: Stunting: length-for-age Z-score (LAZ) < -2 SD, Wasting: weight-for-length Z-score (WLZ) < -2 SD, and Underweight: weight-for-age Z-score (WAZ) < -2 SD.

2.4. Statistical analysis

The data collected were analyzed through statistical packages for Social Sciences (SPSS. version 22.0). Descriptive statistics were used, and the data were presented as frequencies, percentages and means. Independent samples were analyzed using Man-whitny test. In addition, One Way ANOVA was used for parametric data. P-value equal or less than 0.05 was considered as a significance level.

3. RESULTS AND DISCUSSION

Table (1) shows that (22.1%, 38.2% , 16.2% , 19.9% , and 3.6%) of the mothers were at the age of (<25 , 25 -30 , 31-35 , 36-40 and ≥ 41) years old; respectively. As for educational level, (0.7%, 2.9%, 36.1% and 60.3 %) held elementary school level, middle school level, high school level and a university degree; respectively. 83.8 % were not employed compared to 16.2% who were employed. The percentages of mothers who had low (≤3000), medium (3000- 6000), high (6000≥10000) and very high (≥ 6000) income, were (4.4, 24.3, 48.5 and 22.8 %); respectively. Additionally, most of the infants (95.6%) completed (38 – 40) weeks of pregnancy. Regarding infant age (30.1%, 47.8% and 22.1%) was between (4-6, 7- 9 and 10-12) months of age; respectively. The obtained results agreed with Azzeh (2017).

Table (2) shows a significant difference (P < 0.05) between the infant age groups in relation to their height and weight, where height and weight increased with the increase of the infants' age. The growth charts increased rapidly from birth to 5 years of age for both sexes (Ayatollahi et al., 2015).It was noticed that, the increase in weight was minor at the age of (10-12) months. Furthermore, the infants were more physically active at this age as more crawling, walking and jumping were evident (CDC,2018). However, one reason for the slight weight gain might be the intake of insufficient calories that meets the energy needs for daily activity and growth.

3.1. Types of feeding

Table (3) shows the feeding pattern among the infants; it was found that 25.0% were breast fed, 44.9% were bottle fed, and 30.1% were mixed fed. In addition, 16.2%, 31.6%, 36.8% and 15.4 % of the mothers started breastfeeding their infants1 hr, 2-6 hrs , 7-23 hrs and > 24 hrs after the delivery; respectively.

Breast milk is easily digested and suitable for the infants' stomach unlike infant formula that tend to be high in casein, making them harder to digest. Infant formula is an industrially produced substitute for infant consumption. It mimics the nutritional composition of breast milk as closely as possible, and it is based on cow milk or soymilk (Camilia et al., 2016). The results of this study agreed with Elsayed et al (2016) who reported that only 14% of Saudi mothers exclusively breastfed their infants. While, Al Juaid et al (2014) found that the mixed feeding method was common.

The study found that the rate of exclusive breastfeeding was low, thus it did not comply with WHO's recommendations. However, the reason might be that the mother did not receive the necessary support after delivery. In addition, some hospitals use bottles to feed the infants, which discourage the mothers for breastfeeding. Another possible reason, might be that when the infant is born, their sense of taste is very sensitive, able to identify sweet and salty tastes, because infants prefer the sweet taste it may lead to abstain from breast milk after tasting the formula milk.

In this study, most mothers (36.8%) initiated breastfeeding within 7-23 hours after delivery, while only 16.2 % initiated breastfeeding during the first hour after delivery. The results of this study were in the same line with El-Gilany (2011) who found that only 11.4% of mothers started breastfeeding within 1 hour after delivery. While, Ekubay et al. (2018) found that 58.3% of mothers initiated breastfeeding within one hour of delivery. The WHO's recommendations have been to initiate breastfeeding within one hour of birth (WHO, 2017). Therefore, mothers at the risk of delayed breastfeeding initiation should be the targets of breastfeeding promotion during prenatal care (Tamiru et al., 2013). Starting breastfeeding after delivery stimulated the breast to produce colostrum and deliver it to the infants. Colostrum contains antibodies that protect the newborn against infections. Current studies demonstrated that early initiation of breastfeeding was low. A routine separation in the hospital might be one of the reasons for delay in starting breastfeeding, especially among natural deliveries.

3.2. Types of feeding

Table (4) illustrates the number of times the infants were breastfed per day. It was found that 5.9% of the infants at the age of 7-9 months, and 14.7% aged at 10-12 months were fed less than or up to 5 times per day. While 35.3%, 20.7% and 17.2 % at the age of 4-6, 7-9 and 10-12 months respectively were fed 6-12 times a day. Only 5.9% of the infants at the age of 4-6 months were fed 13-16 a day. The number of breastfeeding among infants at the age of 4-6 months was greater than the infants in the other age groups.

The obtained results demonstrated that in general, the number of breastfeeding per day decreased with the increased age of infants, and that infants aged from 4-6 months were the highest number in breastfeeding, while the infants aged 10-12 months were the lowest in numbers in breastfeeding. These findings agreed with Katherine et al. (2008) who showed that the numbers of breastfeeding per day declined from 8 times per day at 1 month to 3.5 times at 1 year. In addition, Saki et al. (2013) reported that the mean number of breastfeeding was 17 at 1 month, while it decreased to 15 feeds at 6 months among the exclusively breastfed infants. The number of times the infants were breastfed decreased with the increase of age, and this was due to the introduction of complementary foods alongside with breast milk.

Table 1: Mothers and infants characteristic

		Freq.	%
Mother profile			
Mother's Age	< 25 years	30	22.1
	25 - 30 years	52	38.2
	31 - 35 years	22	16.2
	36 - 40 years	27	19.9
	≥ 41 years	5	3.6
Educational level	Elementary level	1	0.7
	Middle level	4	2.9
	High level	49	36.1
	University and above	82	60.3
Employment	Employee	22	16.2
	Not employee	114	83.8
Income	Low (≤ 3000 SAR)	6	4.4
	Medium (3000 > 6000SAR)	33	24.3
	High (6000 ≥ 10000)	66	48.5
	Very high (≥10000 SAR)	31	22.8
Infant profile			
Infant age	4 - 6 mo.	41	30.1
	7 - 9 mo.	65	47.8
	10 - 12 mo.	30	22.1
Age of pregnancy	Pre term (< 37weeks)	6	4.4
	Full term (38 - 40 weeks)	130	95.6

Data is represented as frequency and percentage, (n=136).

Table 2: Distribution of the infants according to their length and weight

Anthropometric		N	Mean	STD	P-value*
Length	4 to 6 months	41	64.10 [b, c]	2.544	0.000
	7 to 9 months	65	70.97 [a, c]	4.483	
	10 to 12 months	30	76.05 [a, b]	3.456	
Weight	4 to 6 months	41	6.26 [b, c]	1.618	0.000
	7 to 9 months	65	8.59 [a, c]	1.594	
	10 to 12 months	30	9.60 [a, b]	2.003	

Data is represented as mean, SED,

Table 3: Distribution of the infants according to types of feeding and time of initiating breastfeeding

		Freq.	%
Types of feeding	Breastfeeding	34	25.0
	Bottle feeding	61	44.9
	Mixed feeding	41	30.1
Initiation breast feeding	During 1 hour After delivery	22	16.2
	2 -6 hours After delivery	43	31.6
	7-23 hours After delivery	50	36.8
	> 24 hours After delivery	21	15.4

Data is represented as frequency and percentage, (n=136).

Table 4: Distribution of the breastfeeding infants according to numbers of feeding/day

Exclusive breast feeding (n=34)						
	4 - 6 month		**7 - 9 month**		**10 - 12 month**	
Number of breastfeeding / days	Freq.	%	Freq.	%	Freq.	%
≤ 5 times	0	0	2	5.9	5	14.7
6 - 12 times	12	35.3	7	20.7	6	17.2
13 - 16 times	2	5.9	0	0	0	0

3.3. Bottle feeding

Table (5) illustrated the number of bottle feeding/day. It was found that, there were (16.4, 34.4 and 13.2%) of the infants receiving 2-3 meals/d/at ages (4-6, 7-9 and 10-12 months); respectively. While, (9.8, 21.3and 4.9%) of the infants received 4-5 meals/day at the ages of (4-6, 7-9 and 10-12 months); respectively. Regarding, the amount of each meal, the results revealed that, there were (1.6, 3.3 and 1.6%) of the infants who received ≤ 50 ml/meal at the ages of (4-6 ,7-9 and 10-12 months); respectively. 4.9, 4.9 and 3.3%) of the infants received 60-100 ml/meal at the ages of (4-6, 7-9 and 10-12 months); respectively. While 18, 34.4 and 8.2%) of the infants received 110-150 ml/meal at the ages of (4-6, 7-9 and 10-12 months); respectively. However, (1.6, 13.2 and 4.9%) of the infants received ≥160 ml/meal at the ages of (4-6, 7-9 and 10-12 months); respectively.

3.4. Mixed feeding

Table (6) shows the distribution of infants who were mixed fed (breast and bottle feeding) according to the number and amount of feeding. For numbers of breast feeding /day, it was found that (7.3, 26.9 and 4.9%) of the infants were fed ≤ 5 times at the ages of (4-6, 7-9 and 10-12 months); respectively. 14.6, 17.1and 9.8% of them were fed 6-10 times at (4-6, 7-9 and 10-12 months); respectively. While (4.9, 9.8 and 4.9 %) of the infants were fed 11-15 times at (4-6, 7-9 and 10-12months); respectively.

Most infants regardless of their age received 2 to 3 meals through a bottle/day. It was shown that (17.1, 43.9and 17.1%) of infants received 2-3 meals at (4-6, 7-9 and10-12 months); respectively. While 9.8, 9.8and 2.4% of the infants received 4-5 meals at (4- 6, 7-9 and 10-12 months); respectively. However, there was no infant consume less than ≤ 50 ml, the percentages of infants who received 60 -100 ml/meal at (4-6, 7-9 and 10-12 months) were (7.3, 7.3 and 2.4 %); respectively. 19.5, 29.3 and 9.8 % of the infants received 110- 150 ml/meal at (4-6, 7-9 and 10-12 months); respectively. While 17.1 and 7.3% of the infants received ≥ 160 ml/meal at the ages of (7-9 and 10-12 months); respectively.

Table 5: Distribution of the bottle feed infants according to the number and the amount of each meal

Bottle feeding (n=61)							
		4 - 6 month		7 - 9 month		10 - 12 month	
		Freq.	%	Freq.	%	Freq.	%
How many meals does your infant take from a bottle / day	2 - 3 meals	10	16.4	21	34.4	8	13.2
	4 - 5 meals	6	9.8	13	21.3	3	4.9
Amount of each meal/ml	≤ 50 ml	1	1.6	2	3.3	1	1.6
	60 - 100 ml	3	4.9	3	4.9	2	3.3
	110 - 150 ml	11	18	21	34.4	5	8.2
	≥ 160 ml	1	1.6	8	13.2	3	4.9

Data is represented as frequency and percentage, (n=61).

Table 6: Distribution of the mixed feed infants according to the number and amount of feeding

Mixed feeding (n=41)							
		4 - 6 month		7 - 9 month		10 - 12 month	
		Freq.	%	Freq.	%	Freq.	%
Number of breast feeding/day	≤ 5 times	3	7.3	11	26.9	2	4.9
	6 - 12 times	6	14.6	7	17.1	4	9.8
	13 - 16 times	2	4.9	4	9.8	2	4.9
How many meals does your infant takes from a bottle/day	2 - 3 meals	7	17.1	18	43.9	7	17.1
	4 - 5 meals	4	9.8	4	9.8	1	2.4
Amount of each meal/ml	≤ 50 ml	0	0	0	0	0	0
	60 - 100 ml	3	7.3	3	7.3	1	2.4
	110 - 150 ml	8	19.5	12	29.3	4	9.8
	≥ 160 ml	0	0	7	17.1	3	7.3

Data is represented as frequency and percentage, (n=41)

3.5. Reasons for using bottle feeding

Table (7) shows the reasons given by mothers for not breastfeeding exclusively. The table shows that (27.5%, 30.4%, 8.8%, 23.5%, 1.9% and 7.8 %) of the reasons were due to the availability of bottle milk at anytime and anywhere, not enough mothers' milk, the reluctance of infant for breastfeeding, maintaining the external shape, having problems in the nipple, and the health status of the mothers; respectively.

The most common reason in this study was "insufficient breast milk with the percentage of 30.4%." While Al Faleh (2014) reported that the most common reason for bottle feeding was that the formula has been easily available at any time and place. ElSayed et al. (2016) reported that 86% from Saudi mothers were unsatisfied with EBF, and the main concerns in Saudi mothers returned to EBF not being enough to satisfy the infants.

Table 7: The main reasons for using bottle feeding

Reasons for bottle feeding	Freq.	%
Availability of bottle milk at anytime and anywhere	28	27.5
Mother's milk is not enough	31	30.4
Reluctance of infant to nurse	9	8.8
Maintain the external shape	24	23.5
Problems in the nipple	2	1.9
Health status of the mother (as infections and medication	8	7. 8

Data is represented as frequency and percentage

3.6. Growth rate among infants

Growth rate patterns of the infants according to the types of feeding have been presented in Table (8). The prevalence of stunting was n= 6, wasting was n= 14, and underweight was n= 14 in the infants who received breastfeeding only. The prevalence of stunting was n= 11, wasting was n=10, and underweight was n= 11 in the infants who received bottle feeding only, while the rest of the infants were normal with the percentage of 49.2 %. While, the prevalence of stunting, wasting and underweight was n=11,6 and 11; respectively in the infants who received mixed feeding, while the rest of them with percentage 31.8 % were in the normal growth.

It was noticed that the infants who received bottle feeding were heavier than the breastfed infants, this was due to the formulas containing more protein than the human breast milk. Mothers' milk contained protein with 1.3 g/100 ml (Hester *et al*., 2012). While, formulas were with a protein content of 2–2.5 g/100 ml (Fanaro *et al*., 2010).

However, recent studies showed that high protein content in infant formula was associated with excess weight gain in infancy, which can lead to a 20% risk of obesity later in life (Michaelsen *et al.,* 2014). In addition, breast milk fat content might range from 2-5g/100 ml. The fat content in milk can change dramatically over the course of a single feeding session. Breast milk at the beginning of the session contained lower fat, then the proportion of fat increased at the end of the lactation session, thus, the infants who finished their breastfeeding before emptying the breast were lacking the richest and highest fat of the milk. since fat components had the majority of calories in breast milk. These differences can have a big impact on caloric density (Hester *et al*., 2012), thus, explaining why the majority of bottle-fed infants were normal, while none of breast-fed infants were normal in growth rate parameters.

Table 8: Growth rate according to type of feeding

Growth rate parameters	Indicator	Type of Feeding		
		Breast feeding (n=34)	Bottle feeding (n=61)	Mixed feeding (n=41)
WLZ (Mean ± SD) (-.41- ± 2.50)	Wasting	14 (41.2)	10 (16.4)	11 (26.8)
LAZ (Mean ± SD) (-.08- ± 2.12)	Stunting	6 (16.6)	11 (18)	6 (14.6)
WAZ (Mean ± SD) (-.38- ± 2.28)	Underweight	14 (41.2)	10 (16.4)	11 (26.8)
Normal		-	30(49.2)	13 (31.8)

Data is represented as frequency (percentage)

3.7. Association between the type of feeding with the growth rate

There was a negative significant correlation between WLZ and both breast and mixed feedings, while there was a positive correlation between WLZ and bottle feeding (p=0.004). Regarding LAZ score, both breast and mixed feedings showed a negative significant correlation, while bottle feeding showed a positive significant correlation with LAZ score (p=0.025). The same trend was found in WAZ score, and there was a negative significant correlation between WAZ and both breast and mixed feedings, while there was a positive correlation between WAZ and bottle feeding (p=0.001) Table (9).

Regarding the impact of breastfeeding on WAZ, the current study agreed with Vyas (2013) where it was found that the infants who did not have any breastfeeding at any time during the first months had a higher weight during the 1st year than the infants who had at least some breastfeeding. Dewey *et al.* (1998) found that, after the 4th month, non-exclusively breastfed infants had a higher weight (WAZ and WLZ) than the exclusively breastfed infants. While, the current study disagreed with Kuchenbecker *et al*. (2015) who found that the exclusive breastfeeding of infants under 6 months was associated with higher mean LAZ and WAZ, while for bottle feeding, a statistically significant relationship existed between WLZ and WAZ and the amount of meals ($p < 0.05$). While, the number of bottle feeding / day did not affect the growth rate patterns.

Table (9): Relationship between type of feeding and growth rate indicators

		WLZ	LAZ	WAZ
Type of feeding	**Breast feeding** (n=34)	-1.2162	-0.2153	-1.0459
	Bottle feeding only (n=61)	0.3611	0.4249	0.4277

	Mixed feeding (n=41)	-0.8998	-0.7127	-1.0398
P-value		**0.004**	**0.025**	**0.001**

4. CONCLUSION

This study concluded that even though, the rate of the bottle-fed infants increased compared to the breast- fed infants up to the age of 12 months, bottle feeding had limited benefits to the infants and theirs mothers. The most common reason given by the mothers for not breastfeeding exclusively was that they did not produce enough breast milk. The current practice of feeding of Saudi infants has been nowhere near the compliance with even the most conservative WHO recommendations of exclusive breastfeeding for 6 months. Since the composition of human breast milk is dynamic and changes over time, which may affect infant growth, recommendations have included the improvement of maternal education to ensure the adequate knowledge about proper types of infant feeding. Mothers also have to learn how to correctly practice breastfeeding, and they should be encouraged to breastfeed exclusively for two years.

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