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Beer, Breast Feeding, and Folklore

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Abstract

Beer consumption by nursing women altered the sensory qualities of their milk and the behavior of their infants during breast-feeding in the short term. The infants consumed significantly less milk during the 4-hr testing sessions in which their mothers drank alcoholic beer compared to when the mothers drank nonalcoholic beer; this decrease in milk intake was not due to a decrease in the number of times the babies fed. Although the infants consumed less of the alcohol-flavored milk, the mothers believed their infants had ingested enough milk, reported that they experienced a letdown during nursing, and felt they had milk remaining in their breasts at the end of the majority of feedings. Moreover, the mothers terminated the feeds the same percentage of time on both testing days. The mechanism by which the consumption of alcoholic beer by lactating women decreases milk intake by their nurslings remains to be determined.

Introduction

For centuries, lactating women have been given advice about drinking alcohol. While some advice claimed that the most frequent source of acquired alcoholism was exposure to alcohol in mother's milk, others recommended that the mother or wet nurse drink alcoholic beverages, especially beer, to increase her milk supply and strengthen her breast-feeding infant (Robinovitch, 1903; Routh, 1879). In response to the latter folklore, beer companies marketed low alcoholic beers or "tonics" during the early 1900s as a means for women to stimulate their appetite, increase their strength, and enhance their milk yield (Krebs, 1953).

Even in recent times, beer continues to be hailed as a special beverage for lactation (Falkner, 1987; Grossman, 1987). The consumption of beer, unlike other alcoholic beverages, increases serum prolactin, a hormone necessary for milk production (Carlson, Wasser, & Reidelberger, 1985; De Rosa, Corsello, Ruffilli, Della Casa, & Pasargiklian, 1981; Grossman, 1987). The subjects in these studies were normal men and nonlactating women, however. It is not yet known whether beer consumption has similar effects on the lactating mother, and perhaps more importantly, whether it indeed enhances milk intake by the nursling.

Recently, we demonstrated that breast-fed infants consumed less milk during the 3 hr after their nursing mothers drank a small dose of ethanol in orange juice (Mennella & Beauchamp, 1991a). Because beer, unlike ethanol alone, is reported to have different effects as a galactagogue, we have now evaluated the effects of the consumption of a single serving of beer by lactating women on the feeding behaviors of their infants and the sensory qualities of their milk. We also determined whether the mothers perceived changes in their lactational performance and their infants' behaviors as the result of beer consumption.

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A brief description of some of these data was previously published in a Letter to the Editor of the *Journal of the American Medical Association*, 1993, 269, 1637–1638.

Methods

Subjects

Twelve, nonsmoking, lactating women (5 primiparous, 7 multiparous) who had consumed at least one alcoholic beverage during lactation were recruited from the Philadelphia area. One mother–infant pair was disqualified because the mother did not comply with the nursing schedule. The women (median age = 31.5 years) and their breast-fed infants (9 girls, 3 boys, median age = 150 days) were in excellent health; all but 3 of the infants were exclusively breast-fed during participation in the study. All procedures were approved by the Committee on Studies Involving Human Beings at the University of Pennsylvania and informed consent was obtained from each woman before entry into the study.

Procedure

The methods used in the present study were similar to those described in a previous study (Mennella and Beauchamp, 1991a) except we extended the observation period from 3 to 4 hr. In brief, each mother–infant dyad was tested on 2 days separated by 1 week (± 1 day). Each mother arrived at the Monell Chemical Senses Center at approximately 9:30 A.M., having last fed her infant at approximately the same time on each testing day. Within 1/2 hr of arrival, she expressed a baseline sample of approximately 10 ml of milk, usually from one breast only, with an electronic breast pump (Medela, Crystal Lake, IL.). After the first expression, the mother drank either a 0.3g/kg dose of alcohol in alcoholic beer (Miller, 4.5% v/v alcohol) or an equal volume of “nonalcoholic” beer (Miller Sharp’s, <0.5% v/v alcohol); the mothers weighed, on average, 64.1 ± 2.8 kg. Half of the women drank the alcoholic beer during the first test session and the nonalcoholic beer during the second; the order was reversed for the remaining six women.

Milk samples were again obtained 1, 2, 3, and 4 hr after consuming the beverage. Each sample was immediately placed on ice in an airtight, sterilized glass container. The samples were analyzed within 1 hr after the last collection to determine the ethanol content by means of nicotinamide adenine dinucleotide–alcohol dehydrogenase enzymatic assay (332-UV, Sigma Chemical, St. Louis). At this time, the samples were also evaluated by a sensory panel of adults to determine whether the odor of human milk changes as a function of beer consumption (see Mennella & Beauchamp, 1991a for further discussion of methodology). The amount of milk expressed by each mother did not differ on the 2 testing days (nonalcoholic vs. alcoholic beer: 47.4 ± 3.1 ml versus 50.0 ± 4.2 ml, paired $t(10df) = -0.59$, p not significant).

Each infant was breast-fed at the frequency customary for each mother–infant pair. The babies fed on demand and the mother chose which breast the baby suckled from first and whether the second breast was offered. The infant’s behaviors during breast feeding were monitored by videotape. Immediately before and after each feeding, the baby was weighed (without a change in clothing) on a Mettler PM 15 top-loading balance (Greifensee, Switzerland) to determine the weight of the milk consumed. The volume of milk consumed by the infant (in milliliters) was estimated by dividing the weight of the milk by 1.031, the specific gravity of mature human milk. Immediately after each feeding, the mothers were questioned about their infant’s feeding, whether they experienced a letdown and whether they felt there was milk remaining in the breast at the end of the feeding. The mothers were never told how much milk their infants consumed.

All summary statistics are expressed as Means \pm SEM, p values represent two-tailed tests, and the Yates’ correction for continuity was applied to all chi-square analyses.

Results

Evaluation of the Nursling's Behavior

The infants consumed significantly less milk during the 4-hr testing sessions in which their mothers drank the alcoholic beer, 149.5 ± 13.1 ml, compared to the session in which she drank the nonalcoholic beer, 193.1 ± 18.4 ml, paired $t(10 \text{ df}) = -2.47$, $p = 0.03$; Table 1). This depression in milk intake was becoming evident during the first feeding of the session, nonalcohol versus alcohol: 123.6 ± 13.1 versus 96.7 ± 10.4 ml, paired $t(10 \text{ df}) = 1.76$; $p = 0.11$, which always occurred within 1 hr of the mothers drinking the beverage. Because there was no significant difference in the number of times the infants fed, nonalcohol versus alcohol: 2.2 ± 0.2 versus 2.1 ± 0.2 , paired $t(10 \text{ df}) = 0.56$; $p = \text{ns}$, or the total amount of time they were attached to the nipple, nonalcohol versus alcohol: 20.4 ± 4.0 versus 26.5 ± 4.8 min, $t(9 \text{ df}) = -1.33$, $p = \text{ns}$; (time attached could not be determined for 1 infant), the observed decrease in milk intake was not due to a decrease in the amount of time the infants spent at the breast.

Mother's Perception

There was no significant difference in the mothers' perceptions of various aspects of their infants' behaviors or their lactational performance under the two testing conditions (Table 2). During the majority of feeds, mothers reported that they experienced a letdown during nursing, $\chi^2 = 0.08$, 1 *df*, $p = \text{ns}$, they had milk remaining in their breasts at the end of the feeding, $\chi^2 = 0.01$, 1 *df*, $p = \text{ns}$, and they believed their infants had consumed enough milk, $\chi^2 = 2.62$, 1 *df*, $p = \text{ns}$. Analyses of the video records revealed no statistical difference in the number of times the mothers terminated the feeds on the 2 testing days, $\chi^2 = 0.05$, 1 *df*, $p = \text{ns}$.

Evaluation of the Milk

There was a significant alteration in the odor of the milk samples for each woman on the day she drank the alcoholic beer (Friedman Two-way Analysis by Ranks Test, all χ^2 's > 13.3 , 4 *df*; all p 's < 0.01). The odor intensity peaked 1 hr following the consumption of alcoholic beer, and decreased thereafter. Figure 1 shows that the ethanol content in the milk also changed significantly as a function of the length of time since mothers consumed the beer, $F(28,4) = 56.72$, $p < 0.001$.

There was a small, but significant, change in the odor of the milk samples obtained from 5 of the 11 women on the day they consumed the nonalcoholic beer (Figure 1 inset, Friedman Two-way Analysis by Ranks Test; χ^2 's > 9.5 , 4 *df*; p 's < 0.05 for five cases; ns . for six cases). No ethanol was detected in any of these samples.

Dose of Alcohol Delivered to the Infant

The amount of alcohol ingested by the infants (estimated by multiplying the milk intake by the concentration of ethanol detected in the milk at the collection period closest to the time of the feeding) ranged from 18.6–66.7 mg (Mean $M = 43.1 \pm 5.2$). Taking into account the body weight of each infant, the estimate dose ranged from 2.3 to 8.4 mg per kilogram ($M = 6.1 \pm 0.6$) which was 0.8 to 2.8 percent ($M = 2.0 \pm 0.2$) of the maternal dose (300.00 mg/kg).

Discussion

The consumption of a single dose of alcoholic beer by nursing mothers flavored their milk and decreased the amount of milk consumed by their infants, corroborating and extending our previous report (Mennella & Beauchamp, 1991a). Several factors could account for this decrease in milk intake. First, the infants may be responding to the change in the flavoring of their mothers' milk. It is known that other flavors consumed by the mother, such as garlic, also alter the sensory qualities of human milk, but exposure to garlic-flavored milk increased, rather

than decreased, the infants' suckling behaviors (Mennella & Beauchamp, 1991b). A change in the flavor of mother's milk may result in varied behavioral changes in the nursing which, in turn, depend upon previous experiences and association that the infant has with that particular flavor. Or perhaps the infants were responding to an adverse flavor change that resulted from the transfer of alcohol to their mother's milk.

A second explanation, that the depression in milk intake was due to a pharmacological effect of alcohol on the infant, is unlikely because the infants tended to consume less milk during the first feeding that followed their mother's consumption of an alcoholic beverage. Whether short-term exposure to small amounts of alcohol affects the infants in other ways requires further study. However, it is known that repeated exposure to small amounts of alcohol in breast milk is associated with a slight but significant detrimental effect on the infant's motor development at 1 year of age (Little, Anderson, Ervin, Worthington-Roberts, & Clarren, 1989).

A third explanation is that the decrease in the infant's milk intake may represent a pharmacological effect of alcohol on the nursing mothers. That is, ethanol consumption may affect the milk-ejection reflex, although a previous study concluded this not to be the case for the dosage used in the present study (Cobo, 1973). Moreover, ethanol consumption may alter the composition of milk such that, although infants are consuming less milk, they are taking in the same amount of calories. Chronic ethanol consumption by lactating rat dams during both pregnancy and lactation resulted in the production of a milk that was higher in lipid and lower in lactose content, when compared to the milk of control rat dams (Vilaró, Viñas, Remesar, & Herrera, 1987). Because no alteration in protein or water content was observed, the milk of ethanol-exposed rats had a higher energy content due to the greater energetic value of lipids compared to proteins and lactose. Whether this altered milk composition was due to a direct consequence of ethanol intake or malnutrition is not known. Nor do we know whether ethanol intake, in the short term, has similar effects on milk composition and yield in humans or whether, by relaxing the mother, it facilitates the letdown reflex.

The folklore on alcohol use during lactation also relates that women can benefit from consuming alcoholic beverages because they provide the woman with additional calories and fluids. However, it has been reported that increased fluid intake by the lactating woman does not affect her milk supply or yield (Morse, Ewing, Gamble, & Donahue, 1992). And perhaps a recent study on nursing women in Mexico provides the most relevant findings (Flores-Heurta, Hernández-Montes, Argote, & Villapando, 1992). Folklore in this community relates that pulque, a low alcoholic beverage made of the fermented juice of *Agave atrovirens*, is a galactagogue and women are encouraged to drink as much as 2 liters of this beverage daily during lactation. Although pulque provided an additional energy load of approximately 125 kcal per day to the women, there was no significant difference in their infants' weights at 3 or 6 months when compared to the breast-fed infants of nondrinking, control mothers.

Unlike our previous study (Mennella & Beauchamp, 1991a) where ethanol was consumed in orange juice and the control beverage was orange juice alone, the consumption of "nonalcoholic" beer did result in a small, but statistically significant, change in the odor of the milk samples obtained from 5 of the 11 subjects. Many brands of beer that are labeled as nonalcoholic like the one used in the present study contain some alcohol, that is, less than 0.5% by volume. Although our chemical analyses detected no ethanol in any of the milk samples, an ethanol concentration less than 10 mg/dl cannot be detected by the enzymatic assay (332 UV, Sigma Chemical) used.

Because 31.5 mg ethanol/dl, on average, is transmitted to human milk 1 hr after the woman consumed a 0.3 g/kg dose of alcoholic beer (4.5% ethanol by volume), we would expect the amount of ethanol transmitted to human milk after a woman drinks a nonalcoholic beer

containing 0.4% ethanol by volume (0.03 g/kg dose) to be approximately 3 mg/dl (40 ppm) under some testing conditions; this amount can be detected by the human nose (Fazzalari, 1978). Thus, one explanation for the altered odor on the days these 5 mothers drank the nonalcoholic beer is that panelists were detecting the extremely low levels of ethanol in the milk. Another possibility is that other ingredients in nonalcoholic beer (e.g., barley) were responsible for the altered odor.

Although the infants consumed, on average, 23% less milk following their mothers' consumption of the alcoholic beer relative to the nonalcoholic beer, the mothers were apparently unaware of this difference. Because milk intake and the rate of synthesis of human milk varies from feed-to-feed (Daly et al., 1992), a difference of this magnitude may be difficult for women to perceive (Auerbach, 1990; Fleming, Lawrence, Meier, & Engstrom, 1993). Additionally, unlike the bottle-feeding caretaker who often feeds in response to the amount of formula remaining in the bottle (Wright, 1988), the breast-feeding mother does not have an immediate means of assessing how much milk her infant consumed. Moreover, breast-feeding imparts a more active role to the infant than does bottle feeding. Breastfed infants often determine the pace and duration of the feeding (Matheny, Birch, & Picciano, 1990; Wright, 1988), and indeed the infants in the present study terminated the feedings approximately 70% of the time on both testing days. In addition, breast-fed infants regulate the amount of milk they ingest as evidenced by the finding that milk usually can be expressed from the mother's breasts after a feeding (Daly et al., 1992; Dewey, Heinig, Nommsen, & Lönnerdal, 1991). Interestingly, the mothers felt that they had milk remaining in their breasts at the end of the vast majority of feedings on both testing days. Such perceptions and differences in mother–infant interactions during breast feeding may explain why the folklore that alcohol consumption enhances lactational performance has persisted for centuries.

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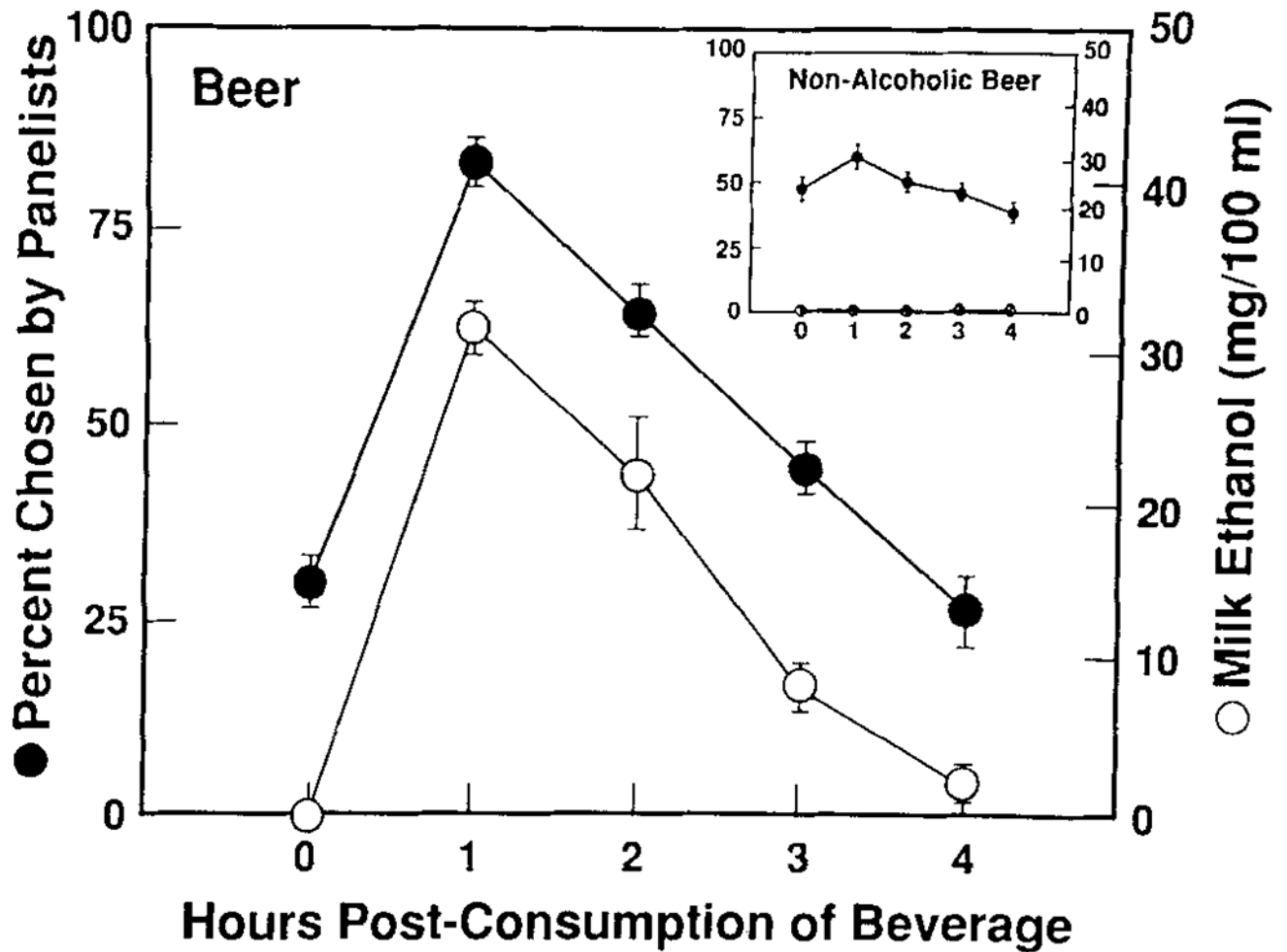


Fig. 1.

The ethanol content of (open circles) and the percentage of time panelists chose (closed circles), milk samples obtained 0, 1, 2, 3 and 4 hr after the mothers consumed a 0.3 g/kg dose of alcoholic beer or an equal volume of nonalcoholic beer (see inset). Using a forced-choice paradigm, the panelists were presented individually with each set of milk samples and asked to indicate which of the pair smelled "stronger" or "more like alcohol." A value of 50% is expected if there is no difference in the odor of the samples and hence response by the panelists is random. Values below 50% for time 0 and 3 hr are a consequence of these samples being paired with a stronger-smelling sample (i.e., samples collected at 1 or 2 hr after beer consumption).

Table 1

The Effect of Maternal Beer Consumption on the Feeding Behavior of Breast-Fed Infants*

	Type of Beer Consumed by the Mother	
	Nonalcoholic	Alcoholic
Total milk intake (ml)	193.1 ± 18.4	149.5 ± 13.1**
Total time attached to nipple (min)	20.4 ± 4.0	26.5 ± 4.8
Number of feedings	2.2 ± 0.2	2.1 ± 0.2

* The amount of milk consumed, total time attached to the nipple, the number of times the infant fed during each of the 4-hr testing sessions. During one of the testing periods, the nursing mother drank a 0.3 g/kg dose of alcoholic beer and during the other day she ingested an equal volume of nonalcoholic beer.

** $p < 0.05$ for the comparison with the session during which the mothers drank the nonalcoholic beer.

Table 2

Mothers' Perceptions*

	Type of Beer Consumed by the Mother	
	Nonalcoholic	Alcoholic
Percentage of feeds that mothers ...		
experienced a letdown	78 (23)	77 (22)
felt baby got enough milk	100 (23)	82 (22)
felt they had milk remaining in breasts at end of feed	74 (19)	78 (18)
ended the feed	33 (24)	26 (23)

* The percentage of feeds that the mothers experienced a letdown, felt their babies got enough milk, felt they had milk in their breasts at the end of a feed, and ended the feed during each of the 4-hr testing sessions. During one session, the nursing mother drank a 0.3 g/kg dose of alcoholic beer, whereas during the other she ingested an equal volume of nonalcoholic beer. The number in parentheses represents the total number of feeds after which the mothers responded. There were no significant differences for any of these measures when compared with session in which the mother drank the nonalcoholic beer.