THE UNIVERSITY OF MANITOBA

SENSORY CHARACTERIZATION OF HUMAN MILK

by

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A B S T R A C T

The taste preferences of the human neonate have been studied by various researchers. However, nothing has been reported of the sensory qualities of human milk. Fore and hind milks from a single morning feed collected from twenty-four nursing mothers over three consecutive days were evaluated for the sensory attributes of sweetness, viscosity and mouthcoat by a trained adult panel using magnitude estimation. The presence and intensity of off-flavours were also noted. Milks were perceived as sweet, thin and low in mouthcoat, but significant differences in the three attributes existed between mothers. Hind milks were perceived as more viscous and more mouthcoating than fore milks, yet these differences were very small. Chemical anlysis revealed significant differences between mothers in lactose, fat and protein contents. A significantly higher fat content in hind milk ($p = 0.001$) was associated with a significantly higher estimation of physical viscosity ($p = 0.002$). Maternal age was negatively associated with fat content ($r = -0.48$, p 0.02). Off-flavours noted in fresh human milk were described as metallic, fruity,

sour and spicy. Frozen milk, subject to more frequent and more intense off-flavours, was described as metallic, cardboardy and soapy. Placement of the milks on a sweetness power function permitted a comparison of intensity of the milks to the basic taste stimulant. Further comparisons of sweetness of human milk to that of other infant foods could also be made. Although significant sensory differences were found in human milks, it is unknown whether the human infant could perceive such changes.

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I N T R O D U C T I O N

Human milk is often the first food offered to an infant. With present trends of increased incidence of breastfeeding, longer duration of breastfeeding, and later introduction of solids, the human infant may be exposed to breast milk alone for a few months before other foods are introduced. Therefore, in the study of the effects of early taste experience upon the development of flavour preference in human infants, it is important to consider the sensory qualities of human milk.

There appear to be no studies reported in the literature describing the flavour of human milk. At the same time there exists a folklore of anecdotal literature about the effects of particular foods in the mother's diet upon her ability to lactate, upon the response of the infant at the breast and later gastrointestinal upset of the infant, and upon the flavour of her milk. Many of the reported effects of foods consumed by the lactating woman upon her milk are part of an oral cultural tradition passed from one mother to another. Sometimes this tradition becomes formalized

into proscribed foods for the nursing mother, and often these food avoidances are reinforced by medical and nutrition practitioners in the advice they give to nursing women.

Studies with laboratory animals such as the rat, have shown that rats formed taste preferences and/or aversions through their experiences with mothers' milk. The effect of mothers' milk upon the human infants' later taste preferences is unknown.

It has been hypothesized by Hall (1975a) that compositional changes in the milk during a single feed could act as an appetite control mechanism whereby the infant would somehow preceive flavour and/or textural changes leading to a sensation of satiety and cessation of feeding. As well, the literature on infant feeding abounds with references to the development of "a sweet tooth". This and other problems such as accelerated growth and infantile obesity have, in the past, been blamed on formula feeding, sweetened formulae and early introduction of solids. These accusations have been made without actual quantification of the relative sweetness of human milk as compared to the sweetness of formulae,

commercial or home-prepared, presently used in infant feeding.

Therefore, the purpose of this research was to examine the sensory qualities of human milk. The objectives of this study were:

1. To define the sensory characteristics of human milk by utilizing a trained adult sensory panel.
2. To note and describe off-flavours in fresh human milk and to relate flavours in milk to foods in the maternal diet.
3. To determine if sensory differences exist in milks of different mothers or between samples from the same mother from day to day or within a single feed.
4. To relate the sensory viscosity of human milk to physical viscosity.
5. To determine the effects of lactose, fat and protein contents upon the sensory qualities of human milk.
6. To determine the effects of freezing upon the flavour and texture of human milk.
7. To test for the effects of certain maternal parameters as age, stage of lactation, parity, frequency of nursing and style of nursing upon the sensory, physical and chemical qualities of human milk.

REVIEW OF THE LITERATURE

I. Development of Taste Preference in Infants

A. First Exposure to Taste Stimuli

An infant is likely exposed to its first taste experience in utero, since it has been reported that taste receptors are developed at twelve weeks of age and that a fetus swallows amniotic fluid beginning about this time (Mistretta and Bradley, 1977). In fact, it has been estimated that between 10 to 15 percent of protein requirements of the fetus were satisfied by amniotic amino acids, and that intrauterine growth retardation was associated with fetuses that could not swallow (Brans, 1976).

B. Infants Responses to Taste Stimuli

1. Neonate

Because of the non-verbal nature of the neonate subject, infants' responses to taste stimuli have been measured in various ways: observation of tongue movements (Jacobs et al., 1977; Nowlis, 1977), facial expressions (Steiner, 1977) heart rate (Lipsitt, 1977),

breathing rate and sucking patterns (Johnson and Salisbury, 1975), volume of taste solution ingested (Desor et al., 1973), and film studies (Drewett and Woolridge, 1979).

Similar conclusions have been reached from these various studies regarding the discrimination of taste in the human neonate. It has been demonstrated that the neonate does discriminate among different taste qualities and over a variety of concentrations and tastants. It has been shown that the neonate clearly prefers sweet solutions over non-sweet ones (Aiyar and Agarwal, 1969; Desor et al., 1973; Steiner, 1977). The neonate preferred certain sweet sugars such as sucrose and fructose over less sweet sugars, glucose and lactose (Desor et al., 1973). The infant preferred more concentrated sweet solutions over less concentrated ones (Crook and Lipsitt, 1976; Desor et al., 1973).

Negative responses of infants to sour solutions have been reported (Aiyar and Agarwal, 1969; Steiner, 1977), but these researchers used very high concentrations of tastants in their experiments. By using weaker solutions of tastant, Desor, Maller and Andrews (1975) found that the addition of citric acid to a sucrose solution significantly

decreased the volume ingested by neonates, but a similar addition of bitter tastant, urea, and of salty tastant, sodium chloride, did not significantly alter the amount of sweet solution ingested. Desor, Maller and Andrews (1975) also found that volume of weak aqueous solutions of sour and bitter tastants did not significantly differ from the volume of water ingested. They attributed this lack of difference to a possible aversion to water in the human neonate.

Thus, it seems that the human neonates prefer sweet and are aversive to strong solutions of sour and bitter. It remains unclear whether very young infants find weak bitter solutions aversive.

Salty solutions have not been tested often, due to the fear of introducing a dangerous level of hypertonic solution to the neonate. Johnson and Salisbury (1975) found salt solutions to cause apnea, or to be inhaled, by newborn infants. Negative responses to salty taste were reported by Aiyar and Agarwal (1969) and Jensen (1932). Desor, Maller and Andrews (1975) reported indifference to sodium chloride solution of 3-200 mM (or 0.017 - 1.17 percent) in infants of 1 - 4 days of age. Conner (1979)